

Table 1.
Laboratory Data.

Date	Before the operation		Operation	After the operation		
	1945 Dec 16	1946 June 18	1946 June 20	1946 June 23	1946 June 27	1947 Sept 9
Hb, per cent	77	103			99	95
RBC, millions	3.4	4.6			5.6	4.8
WBC	2 200	2 200			13 900	7 200
Thrombocytes	116 645	117 500		245 625	512 500	374 000
Bleeding time		14 min.	5.5 min.		4 min.	3 min.
Coagulation time ..		2.5 min.			3 min.	2.5 min.
Sedimentation rate.	18 mm	7 mm			33 mm	6 mm
Takata		neg.				neg.
The benzidine reaction in the stools was positive during the first eight days of the hospitalization period, but was negative later on.						

the size of the brain of an adult male was exposed. There were no adhesions and the spleen was easily removed. The splenic pedicle was about 4 cm long and very thick. The splenic vein had a diameter of that of a thumb. No thrombosis of the vein could be felt. The liver was perhaps a little more firm and dry than usual with a sharp lower edge. The operation was technically simple and did not cause much bleeding.

The weight of the spleen was 1 kg. *P. A. D.* (REIDAR EKER): *Spleen with fibrosis.*

The patient was running a fever for four weeks after the operation (38—38.5° C), but the postoperative course was otherwise uneventful, and she was discharged in good condition 33 days after the operation.

On a control examination on Sept. 27th, 1947, *i. e.*, fifteen months after the operation, the patient told that she felt fine, had been feeling stronger than previously and had carried out usual housework all the time. She had gained 3—4 kg in weight. The abdomen was normal, the scar firm and solid.

Roentgenograms of the esophagus (Oct. 1st, 1947) showed that the previous jagged contour of the esophagus could no longer be seen, although some areas of translucency could still be seen in the contrast shadow. R: *Esophageal varices with evidence of regression.* (Pl. I, fig. 4.)

From table I it will be seen that the number of white cells and thrombocytes fell to normal values after the operation.

ACTA CHIRURGICA SCANDINAVICA



SUB TITULO

NORDISKT MEDICINSKT ARKIV

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Among the 400 odd cases of gall stone that have been operated on here during the past five years, 47 have been cases of choledochus stone. 19 of these ran their course without icterus. In ten of the other 28 cases the differential diagnosis between hepatitis and choledochus stone was not clear so a blood analysis was made. The laboratory diagnosis was correct (mechanical obstruction) in only 50 % of these cases. In the remaining five cases the diagnosis indicated hepatitis. Two of these five have been described above. In two of the remaining cases the increase in phosphatase was rather insignificant whereas the citric acid value was excessively increased so that it is perhaps probable that the conditions in these were the same as in the two first cases. On the other hand the fifth case showed a marked increase in the phosphatase value (23 units) together with a very high citric acid value (42 micrograms). It is probable that in this case there was a combination of parenchymal icterus and obstructive jaundice without, however, the possibility of being able to decide which was primary.

As the writer have previously stated, various investigators have come to the conclusion that hepatitic changes are often brought about by both acute and chronic cholecystitis. It is therefore believable that, on the other hand, the curing of an acute hepatitis can be made more difficult by the presence of a cholecystitis even if there is no obstruction in the biliary ducts. We have had two cases of hepatitis which both pointed to such conditions.

Case III. Married woman, aged 59. From $\frac{9}{1}$ to $\frac{13}{2}$ 1946 she was treated in the Medical Department of the Västerås Hospital for acute hepatitis which began in the middle of December 1945. No stone pains. Liver enlarged extending one finger-breadth below the arcus costarum. Laboratory analysis on $\frac{23}{1}$ was: *citric acid in the serum 42.7, serum phosphatase 16.8, Meulengracht 45. Hepatitic values.* When she was discharged on $\frac{13}{2}$ she was free from icterus: Meulengracht 6. Shortly after getting home she had a relapse of hepatitis. Was again treated in the Medical Department in Västerås from $\frac{10}{3}$ to $\frac{10}{4}$ 1946. The enlargement of the liver had increased somewhat. Laboratory analysis on $\frac{28}{3}$ was: *citric acid in the serum 44.1, serum phosphatase 18, Meulengracht 14. Hepatitic values.* When discharged again she was free from icterus: Meulengracht 7. A couple of weeks after returning home she had another relapse. Laboratory analysis on $\frac{18}{5}$ was: *citric acid in the serum 53.2, serum phosphatase 19, Meulengracht 25. Operation on $\frac{20}{5}$, when an enlarged liver was encountered extending two finger-breadths below the arcus costarum. Pronounced hepatitis changes, the liver diffusely and finely nodulated on the surface. The gall bladder,*

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Table 1.

Case and Sex	Age at onset of		Age on operation	History of trauma	Shortening	Condition of the other hip	Operation	Bony union
	limp.	pain						
1. A. I. 1334 F.	5	17	22	no	7 cm	normal	osteotomy	no
2. T. L. 747 M.	2	2	15	no	0	coxa vara	osteotomy	in 4 months
3. P. K. 1627 M.	6	6	24	yes	5.5 »	normal	osteotomy	in 7 months
4. E. A. 488 F.	2	2	20	no	0	coxa vara	osteotomy	no
5. A. O. 2072 F.	5 —	10 —	17 18	no —	7 —	coxa vara —	osteotomy Brackett operation	no in 4 months
6. E. S. 2496 F.	2	17	17	yes	3 »	normal	Brackett operation	in 9 months
7. H. L. 2216 F.	5	11	17	no	5.5 »	normal	Brackett operation	in 15 months
8. L. H. 3225 M.	2	2	21	no	6 »	normal	Brackett operation	in 6 months
9. A. P. 2778 F.	2	2	35	no	4 »	coxa vara	Brackett operation	in 8 months
10. K. K. 3321 M.	7	7	21	no	4 »	normal	Brackett operation	in 2.5 months
11. M. N. 3299 F.	7	15	17	no	3 »	normal	Withman reconstruction	no

McMURRAY in traumatic pseudarthrosis of the femoral neck, in which cases this operation has given the writer very good results. In contrast to these the coxa vara cases gave what must be admitted to be disappointing results. Bony union was obtained in only two cases, correction of the former deformity in none, full weightbearing in none. However in three cases the gait improved and the limp and pain diminished so that the patients could walk without support. The range of flexion was 45, 60 and 70 degrees.

On Acute Pancreatic Affections Following Gastric Resection for Ulcer or Cancer and the Possibilities of Avoiding them.

By

ERIK MILLBOURN.

Among postoperative complications of gastric resection for ulcer or carcinoma, acute pancreatic affection¹ and pancreatic fistulae are regularly met with in the large series. These complications also occur in cases where the ulcer or carcinoma has not involved the pancreatic tissue. Many regard the pancreas as a powder-magazine in the human body that is off and on capriciously brought to explode for minor reasons but that on other occasions is entirely unaffected even when the gland has been rather much injured at operation.

Different etiological factors are conducive to the appearance of these acute postoperative affections of the pancreas. It is not the intention to give a detailed account here of these complicated conditions and problems. The author will merely point to the following etiological factors. 1. *Mechanical injury* to the pancreatic tissue, from the mildest such as tractions in the pancreas or hard-handed palpation to the most severe entailing breaks in the continuity of the gland's tissue. 2. *Vascular injuries* and disturbances, especially such involving the superior and inferior pancreaticoduodenal and splenic arteries. If there are no anomalies present, however, the gastro-duodenal or the superior pancreaticoduodenal artery may be ligated without risk, a fact of importance, as a duodenal ulcer sometimes involves these vessels or any of their branches in different manners. In view of the possibility of vascular anomalies being present it is advisable at every *ulcer re-*

¹ The term acute pancreatitis is rarely adequate and is to be avoided.

section to free the greater curvature of the stomach between this and the principal trunk of the art. gastro-epiploica dextra in order by this means to increase the possibilities of collateral circulation as a precaution against an unexpected ligature of the art. gastro-duodenale or pancreatico-duodenale sup. (BOHMANSSON and others). 3. *Stagnation of the duodenal contents* (ileus, circulus vitiosus), with its influence on the excretory function of the pancreas, possibly with regurgitation of bile or duodenal contents into the pancreatic duct system. 4. *Spasm* of the muscles round the orifice of the pancreatic ducts.

The etiological factors 3 and 4 are probably of subordinate importance (note, however, SCHMIEDEN and SEBENING's, PERMANS as well as USLAND's solitary observations of acute affection of the pancreas after a simple gastro-enterostomy). A debatable problem is that of inactive/active pancreatic juice and the circumstances under which activation can take place. The secretory phase in which the pancreas happens to be at just the moment when the acute affection is established is undoubtedly of etiological significance.

Another etiological factor has been demonstrated or pointed out by several authors, viz. that more or less 5) *isolated lesions of the duct system* can result in acute postoperative affection of the pancreas or (directly or indirectly) pancreatic fistulae (CLAIRMONT, KEYL, SCHWARZ, HULTÉN, CEDERMARK, MILLBOURN and others). In SCHMIEDEN and SEBENING's statistics 11 of 91 acute pancreatic affections following gastric operations are due to ligature of the duct of Santorini.

The general view is that the pancreatic complications are most apt to arise if at operation the ulcer niche or the carcinoma penetrates to the pancreas. Some authors, SCHMIEDEN and SEBENING for instance, speak in this connection of a "general predisposition to pancreatitis", although no definite proofs of such are forthcoming. In the present author's opinion, against such a "predisposition" argues in the first place the fact that acute pancreatic affection of clinical rank is a rarity in gastric ulcer and carcinoma except just in the postoperative course. USLAND, for instance, has registered normal diastase values (max. 64) pre-operatively in 21 cases of ulcer penetrating to the pancreas. BLOCK has recorded values of at highest 166.6 (in serum and urine) in 38 cases of duodenal or gastric ulcer, i. e. normal values. One case with perforation to the pancreas showed a value bordering on the patho-

logic — 320. Thus, the operative interference as such must be considered as an etiological factor to a high degree.

The duct lesions can arise in various ways. Even at the time of the operation there may be a macroscopically visible fistula of the pancreatic duct in the base of the ulcer crater (such cases have been described by BOHMANSSON and according to HULTÉN, also by BRANDT and FINSTERER). If such a fistula is left unattended, it is easy to imagine the consequences. In other cases the duct lesions are caused during the operation, when the base of the ulcer is being extirpated. A lesion may arise secondarily following upon an electro-coagulation of the ulcer-base left on the surface of the pancreas at operation. HULTÉN considers that in the circumstances now described duct injuries mainly fall upon the duct of *Wirsung* because this runs near the surface of the pancreas close to and parallel with the common bile-duct a good stretch before it bends almost at right angles off towards the body-tail part. Just this kneeshaped portion of the duct is regarded by HULTÉN as being a specially exposed point, as it undoubtedly is. That part of *Wirsung's* duct which runs between this knee and the greater papilla is, however, not very likely to be injured, for it does not lie as superficial towards duodenum as HULTÉN presumes. It lies deeper in the head, dorsally to the duct of Santorini and the latter's parenchymal area.

From his anatomical studies of the pancreatic and biliary ducts, which were started during 1942, *the author has arrived at the view that the risk of duct lesion at resections of the stomach is especially great as regards Santorini's duct.* This duct always opens at the lesser papilla, situated cranio-ventrally to the greater papilla (Vater's). Duct lesions ought then as a rule to occur at the point where the duct leaves the pancreatic tissue in order to perforate the duodenal wall. CLAIRMONT and KEYL are of the same opinion. An excessive duodenal mobilization, especially if it is performed in an unsuitable direction (ventrally) may often be the cause of these usually unintentional duct lesions that are not observed during the operation. If the post-operative course terminates lethally, it is difficult at autopsy to obtain a clear conception of the duct relations and the point of lesion.

Earlier anatomical studies of the pancreatic ducts, their relations to one another, to the biliary duct and to the duodenum, have given results that on many points do not agree with or even contradict one another. X-ray examination of cadaver specimens

after contrast injection into the ducts (biliary and pancreatic) together with gross-anatomical observation and preparation of specimens has proved to yield considerably more exact results than other methods of investigation have been able to show. MILLBOURN published in 1943 the results of such examinations on 130 cases, and similar studies of the material increased to 200 cases are being published in *Acta Anatomica*, 1949. HJORTH published in 1947 a similar investigation of 100 cases with finds that were in good agreement. The method employed by HJORTH does not admit of so searching a scrutiny of anatomical details, this mainly depending on his having only made contrast injection into the pancreatic duct from the cauda pancreatis (his clinical purpose did not on the whole demand a more exact method).

These investigations show that in about 90 % the duct of Wirsung serves as the sole or chief efferent channel of the pancreatic parenchyma (182 of the present author's 200 cases. P. I. Figs. 1 and 2). In these cases, therefore, the risk of duct lesions arising mainly depends on the close course of this duct to the pancreas surface in the proximal part of the head (HULTÉN). To this it may be added that lesioning risks also exist if a gastric ulcer penetrates the tissue of the corpus or cauda of the pancreas, for in this region the pancreatic duct often lies eccentrically, ventro-proximally, in the transverse section of the pancreas, this having been observed by the author in his duct studies (exact numerical data cannot be submitted by the author). The same statement has been made by CATTELL. The data in the literature, however, are not concordant. BALDWIN, for instance, states that as a rule the pancreatic duct runs more dorsally than ventrally in the corpus and cauda as well.

The present author's duct investigations show that *the duct of Santorini* (generally and unfortunately called the "accessory" duct¹) *occurs in 93 of the 182 cases with the duct of Wirsung as the sole or main efferent channel* (50 % of the cases). In every third case (calculated on 182) the calibre of Santorini's duct is such that *in vivo* it can probably act as a substitute for (Pl. I Fig. 1) or relieve (Pl. 1 Fig. 2) Wirsung's duct. In every fifth case — 39 of 182 — it was so large-calibred that it was judged capable of functioning substitutingly. *The duct of Santorini always terminates*

¹ The term, "accessory" duct for the duct of Santorini is not always adequate (see p. 6) and is therefore to be avoided.

at the lesser papilla, situated cranio-ventrally in relation to the greater papilla — Vater's (BALDWIN, MILLBOURN, etc.). Now, if the duodenal mobilization from normal or pathologic pancreatic tissue is done too thoroughly, this duct is certainly very apt to be ligated, cut off or burnt off by diathermy without the operating surgeon noticing it (should the operator observe the duct, he often takes it to be a blood-vessel). If the ligature holds, nothing abnormal occurs in these cases, the flow of secrete presumably passing as easily to the duct of Wirsung. NOWAK's view that the duct of Santorini can be ligated without consequences must be based on cases of this description. NOWAK reports, in fact, that he has ligated the duct of Santorini on several occasions without any trouble arising. If for some reason the ligature dissolves (cat-gut, for instance), or if the duct is not ligated at all, the pancreatic juice may be excreted into the partially ulcerated bursa-omentalis region. In many cases this may not have serious consequences if the leakage of juice is not very extensive, in other cases it will be followed by 1) a more or less circumscribed abscess, 2) peripancreatic changes of the type that occurs in acute pancreatic affection or 3) in a pancreatic fistula. In the worst cases exitus may follow. In the probably relatively rare cases (SCHWARZ, BALDWIN, HELLY, NÄÄTÄNEN, MILLBOURN) in which the duct of Santorini serves as the sole excretory channel for a parenchymal area isolated from the large duct system of Wirsung (a half or some few percent of the cases), the consequences probably need not be so serious either, (1) if the parenchymal area of the duct of Santorini is relatively small, (2) provided ligature is applied and (3) the latter holds (Pl. I Fig. 3 *a* and *b*, although here the parenchymal area of the duct of Santorini is comparatively large).

From his duct material the author can submit examples showing that the duct of Santorini having communication with both the duodenum and the duct of Wirsung can be severed at duodenal mobilization without trouble resulting. The patient was operated upon in 1941 for gastric ulcer with Billroth II at the Surgical Clinic of Lund (Jrn. No. 2116) and had a perfectly smooth postoperative course. The highest temperature was measured the day after the operation; it was 38.3° C, and became normal as from the 5th day after operation. Diastase tests of the urine were not made. At operation the duodenum was mobilized laterally and from above according to Kocher's technique and was divided between Schoemaker's clamps 2 cm. below the pylorus. In the

operation report there is nothing to suggest that the duodenal mobilization involved anything remarkable. The patient died in 1944 of pulmonary tuberculosis. X-ray examination of the duct anatomy on the autopsy specimen and the macroscopical examination showed that the duct of Santorini terminated blindly on the surface of the pancreas with an abruptly rounded end. On the autopsy specimen it could be seen that the detachment of the duodenum at the operation in 1941 was done so near the greater papilla that the duct of Santorini had undoubtedly become ligated.

In about 10 % of cases the duct of Santorini functions as the sole or chief excretory channel of the pancreatic parenchyma (18 of the author's 200 cases belonged to this duct type). In these cases, too, Santorini's duct opened at the lesser papilla in the duodenum cranio-ventrally to the greater papilla, Vater's (Pl. II. Fig. 4 *a* and *b*). The underlying anatomical conditions that favour an injury to this duct at duodenal mobilization are therefore the same as have been described in the case of the duct of Santorini when it acts only as an accessory channel, though with the difference that on account of its greater calibre the duct is more likely to be discovered by the surgeon. If a Santorini duct of this kind is ligated at gastric resection, the consequences would doubtless be severe. This is also illustrated by a case from the Surgical Clinic of Lund (J. No. 812/1943). In spite of our having had our eyes open for the risk of ligating the duct of Santorini the experienced operator did not observe the duct and nor the fact that it was ligated at the duodenal mobilization — beyond the ulcer cake, which was the size of a walnut. After the operation the patient was from the very beginning more affected than is usual. An elevated diastasia (above 512) persisted the whole time after the operation except the last two days preceding death, when the level bordered on the normal (256). The maximum value (16384) was measured on the day following operation and on the urine excreted during the first 24 hours. Eight days after the operation there occurred a rapid deterioration as well as difficulties in the evacuation of the stomach and in intestinal passage. Exitus followed four days later (Fig. 5).

The post-mortem report: Basally in the right pleural cavity are loose deposits of fibrin.

When the abdominal cavity is opened, about 2 litres of cloudy, slightly flocculate fluid is found especially in the right upper part of

the abdomen. Disseminated haemorrhages and a thick coating of fibrin are observed on the lower surface of the right diaphragma and adjacent parts of the right liver lobe.

The omentum, which is broadly fixed in the region of the coecum, delimits the area of exudation. The whole of this delimited wall shows extremely dense and large fat-necrosis, which even pierce the tissue into the porta hepatis. It may be added that the peritoneal exudate does not display any bile pigment, just as the skin had no signs of being jaundiced either. Fat-necrosis further occurs to a large extent

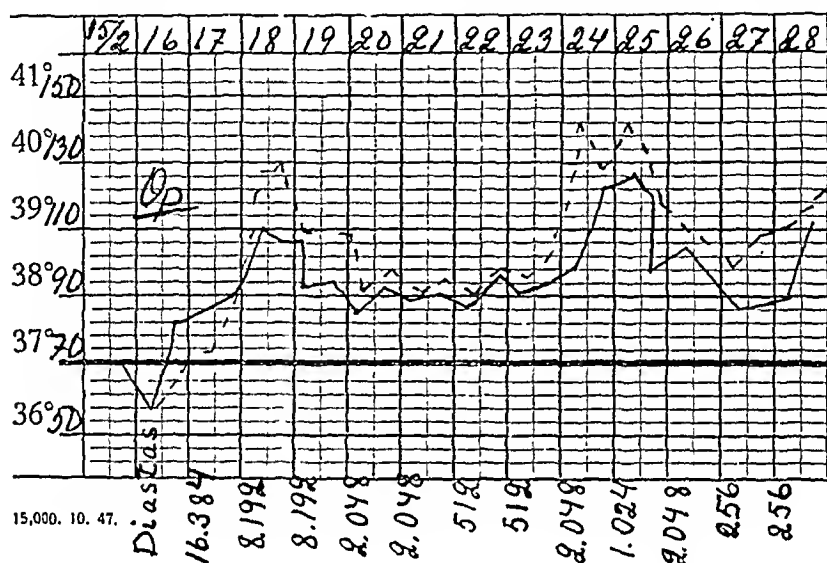


Fig. 5. Temperature and Pulse Curve together with Diastase Values of Gastric Resection Case. Broken line = pulse rate, continuous line = temperature.

also in the mesentery of the ileum, and is also found in the left lateral surface of the abdominal cavity.

The sutures in the duodenal stump hold irreproachably, as do also those in the gastro-enterostomy, which affords good passage.

The pancreas shows normal size and compactness on the surface. A longitudinal cut laid through the pancreas likewise exhibits to the naked eye an unchanged section-surface.

Pancreas, duodenum and choledochus were taken out *en bloc* and the X-ray examination carried out by the author after contrast injection into the common bile-duct showed that the excretory channel running from the pancreas and terminating in the ductus choledochus — ductus Wirsungi — is very small and that this excretory channel belongs to only a small parenchymal area in the head of the pancreas, which is without visible duct communication with the larger parenchymal area (Pl. II Fig. 6 a). Contrast-injection from the tail of the pancreas reveals that the duct of Santorini is the principal efferent channel of the pancreatic parenchyma and that in this case it terminates freely on the surface of the pancreas at the point from which the duodenum had been detached (Pl. II Fig. 6 b).

Obviously the duct had been ligated and severed at the operative mobilization of the duodenum (Fig. 7).

By an oversight the pancreas was not made the object of a microscopical examination. The noteworthy feature, of course, is the macroscopically normal sectioned surface of the pancreas. Microscopically it might have been possible to demonstrate the residues of an extinguished state of stasis.

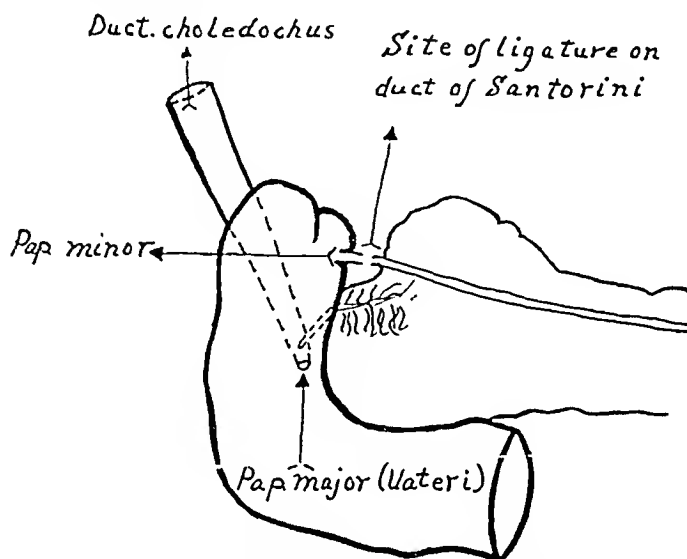


Fig. 7. Sketch showing Duct Anatomy with Site of Ligature on Duct of Santorini in Gastric Resection Case.

Summing up, attention may be drawn in this lethally terminating case to the fact that, from the beginning of the postoperative course, the patient was more affected than normally, with abnormally high pulse and temperature reactions and with an initially increased diastasia that showed falling values day for day. This section of the clinical course undoubtedly corresponds to the period of time during which the ligature on the duct of Santorini keeps tight: the falling diastase levels are an expression of a commencing failure of the pancreas to perform its excretory function. Following duct ligation on animals it has, for instance, been established that the diastase curve in serum and urine has the same course (WOHLGEMUTH, etc.). Eight days after the operation the patient suddenly becomes ill, which doubtless corresponds to the moment when the ligature releases its hold. The pent up pancreatic juice flows out into the site of operation and gives the shock-like clinical picture ending in death. Temperature, pulse rate and diastase levels rise, the last-mentioned probably



Fig. 1. Cholangiogram: The duet of Wirsung is the main efferent channel of the pancreas parenchyma. The duet of Santorini is well developed and can probably function substitutingly for the duet of Wirsung.



Fig. 2. Cholangiogram: The duet of Wirsung is the main efferent channel of the pancreas parenchyma. The duet of Santorini is well developed. Its opening into the duodenum is so narrow that the duet can probably only relieve the duet of Wirsung.



Fig. 3 a. Cholangiogram: The duet of Wirsung is the main efferent channel of the pancreas parenchyma



Fig. 3 b. Radiogram taken after contrast injection also from the lesser papilla, showing a relatively large duet system of Santorini that is without visible communication with the larger system of Wirsung. (Radiogram blurred owing to the contrast medium, lithium iodide, having diffused out into the pancreatic tissue.)

Fig. 3 a and b Radiograms of Rare Pancreatic Duet Variants.



Fig. 4 a Cholangiogram: Filling of a relatively large duct system of Wirsung



Fig 4 b Radiogram after supplementary contrast injection from tail portion of pancreatic duct: the duct of Santorini functions as the main draining channel of the pancreas parenchyma

Fig. 4 a and b Radiograms of Chief Type: The biliary and pancreatic ducts enter the duodenum at separate points.



Fig. 6 a Cholangiogram: Only a small duct system of Wirsung filled.



Fig 6 b Radiogram after contrast injection also from the tail portion of pancreatic duct: the duct of Santorini is the main efferent channel of pancreas parenchyma and it terminates on surface of pancreas at point from which duodenum has been released

Fig. 6 a and b. Radiograms of Gastric Resection Case

owing to an increased pancreatic activity evoked by the stasis relief following the dissolution of the duct ligature. The post-mortem picture observed of a macroscopically normal pancreas with disseminated changes — mainly localized to the right — of autodigestive character and typical of an acute pancreatic affection also fits in well with this re-constructed course.

CLAIRMONT and WALZEL each describe a case of similar nature, though the duct anatomy was not made perfectly clear in either case. CLAIRMONT intentionally ligated a pancreatic duct at its transition from pancreas surface to duodenum. Postoperatively there followed local symptoms of peritonitis and, after debridement of the wound, pancreatic fistula. Exitus 8 days after operation. No autopsy. WALZEL reports one case where the operating surgeon — NOWAK — during a Billroth II at the same site ligated a duct that was taken to be the duct of Santorini without lumen. Pancreatic fistula followed. Exitus a fortnight after operation. At autopsy, changes typical of acute pancreatic affection were found in the operative area round the head of the pancreas, on the surface of which a pancreatic duct terminated. From the papilla of Vater no pancreatic duct could be sounded. There was no suture insufficiency. In this case, thus, the duct of Santorini had *probably* functioned as the sole or main efferent channel of the pancreas parenchyma. EURÉN refers to a resection case (Billroth I) for duodenal ulcer, published by BUNDSCHUH, with exitus $2\frac{1}{2}$ days after operation in peritonitis with fat-necrosis. Autopsy disclosed that the duct of Santorini was the only excretory channel of the pancreas and entered the duodenum 1.5 cm. from the site of resection. BUNDSCHUH assumes that the post-operative oedematous swelling in the duodenum had created an obstruction to the outflow of pancreatic juice, which instead had penetrated into the abdominal cavity via the lesion in the pancreatic parenchyma caused at the operation in the ulcer region.

The author's own observations show that in about half of all surgical cases there exists the risk that on separation of the duodenum from pancreas tissue the operator will come in contact with a functioning duct of Santorini opening at the lesser papilla. In close upon every tenth case of operation a lesion of this duct, with or without ligature, involves great risks for the patient, that is, in those cases in which the duct of Santorini acts as the sole or main excretory duct of the pancreatic parenchyma, in the latter case without anastomosis to the duct-system of Wirsung. In other surgical

cases a ligature of the duct of Santorini may not matter. If the duct is lesioned without a ligature being applied, the consequences may certainly be severe owing to the fact that pancreatic juice is discharged into the field of operation.

As a matter of fact, the juice-stream in the pancreatic duct can pass backwards even at the end of the tail of the gland. This is shown, *inter alia*, by one of the author's cases of spleen extirpation at the Lund Surgical Clinic (No. 3191/47), in which at extirpation of a spleen weighing more than 2 kgs. the author could not avoid injuring the end-portion of the cauda pancreatis. An abundant reflux of pancreatic juice followed from the drain-opening for more than a week after the operation.

Postoperative Diastase Studies on Gastric Resection Patients.

One of the most convenient and moreover one of the most reliable methods of establishing the presence of acute pancreatic affection is by determinations of the urinary diastase by the Wohlgemuth procedure. The state prevailing after the operation can be compared with an acute abdominal condition, and therefore only values of 512 or higher are ranked as pathologic (Skoog, Foged, Millbourn, etc.). According to the experience so far available, the question whether the acute disturbance is of mild or serious character cannot be decided either by the height of the diastatic index or by the number of days the diastasuria is elevated.

Since 1943 diastase tests have been made to a rather great extent on the urine (by Wohlgemuth's method) after gastric resections. The material amounts at present to 147 cases, but the sampling has not been conducted regularly or alike in every case (Table 1).

Table 1.

Number of Postoperative Diastase Tests in 147 Cases of the Material.

No. of Tests	No. of Cases
1	21
2	26
3	36
4	17
5	22
6—9	18
11—19	7

Among the diastase-tested cases, 13 = 9 % have shown an increased diastasuria with levels of 512 or higher on one or more test occasions, suggestive of an acute involvement of the pancreas. (Table 2.)

Table 2. $\frac{13}{147}$ =

Postoperative Diastasuric Conditions in All the 147 Diastase-Tested Cases. (130 Billroth II and 4 Billroth I Cases as well as 13 Cases of Resection for Exclusion by Finsterer's Method.)

512 or higher	13 cases = 9 %	} 19 %
256	15 "	
< 256	119 "	
	<hr/> 147 cases	

USLAND has studied the diastasuria after gastric resection for ulcer in 24 cases, values of 512 or higher being registered in 3 of them, *i. e.* in 13 %. GRASSBERGER has studied the serum diastase after gastric resection in 9 cases and found raised values in one.

The greatest interest in this connection attaches to the 87 cases in which diastasuria was already registered during the first 24 hours following operation (84 cases of Billroth II and 3 of Billroth I — 6 cases that underwent resection for exclusion by Finsterer's method are not included). According to experimental and clinical experience, a duct lesion (with or without ligature) ought to manifest itself immediately after the operation by an increased diastasuria. Table 3 supplies data as to the number of consecutive days on which diastase tests were made in the 87 cases.

Table 3.

Number of Postoperative Diastase Tests in the 87 Cases in which the Diastasuria was Tested Immediately after Operation.

No. of Days in Succession Dias- tase Tests were made	No. of Cases
1	8
2	14
3	24
4	13
5	12
6—9	11
11—19	5

Nine of the 87 cases had increased diastasuria on one or more testing occasions, *i. e.* 10 % of the cases tested in this respect.

(Table 4 a.) The question is whether these diastase-tested 87 cases can present any features that argue in favour of its being just the duct injury which is the cause of this immediate post-operative diastase rise.

Table 4 a, b and c.

Diastasic Conditions in the 87 Cases Diastase-tested Immediately After Operation (84 Billroth II and 3 Billroth I Cases).

a)

512 or higher	9 cases = 10 %	} 20.6 %
256	9 "	
< 256	69 "	
	<hr/> 87 cases	

b)

<i>With Pancreas Involvement</i>			<i>Without Pancreas Involvement</i>		
512 or higher .	4 cases = 12 %	} 18 %	5 cases = 9.3 %	} 22 %	
256	2 "		7 "		
< 256	27 "		42 "		
	<hr/> 33 cases		<hr/> 54 cases		

c)

<i>Duodenal Ulcer</i>			<i>Gastric Ulcer or Carcinoma</i>		
512 or higher .	7 cases = 17 %	} 31 %	2 cases = 4 %	} 11 %	
256	6 "		3 "		
< 256	29 "		40 "		
	<hr/> 42 cases		<hr/> 45 cases		

$$\begin{aligned}
 7 \text{ of } 42 &= 17 \pm 5.8 \% \\
 2 \text{ of } 45 &= 4 \pm 2.9 \% \\
 &13 \pm 6.5
 \end{aligned}$$

To get a clearer view on this point the author has divided the 87 cases with reference to (1) whether the ulcer or carcinoma has involved the pancreatic parenchyma or not, (2) whether the diagnosis has been duodenal ulcer on one hand and gastric ulcer or gastric carcinoma on the other. This division shows that whether the pancreas is involved in the pathologic process or not increased diastasia is about as common, respectively 12 and 9.3 % (see Table 4 b). If involvement as such, coupled with necessary operative manipulations of the pancreatic parenchyma, were of any significance, the frequency of increased diastasia ought to have been higher in the pancreas-involved cases. It may be added that as a rule all operators have dealt as leniently as possible with the pancreatic tissue. For instance, only in 5 of the 33 pancreas-involved cases has the ulcer base or cancerous tissue been

excised from the pancreas. An immediate postoperative elevation of the urinary diastase followed in 1 of these 5 cases. The reason for the rise in this case seems clear to the author, since the operating surgeon had ligated a severed pancreatic duct that could be probed a little towards the pancreas and that during the operation delivered a clear colourless juice. Whether the lesion has arisen at the excision of the ulcer or at the duodenal mobilization, is not clear from the surgical report.

A division of the 87 cases between the two other groups, *viz.* *ulcus duodeni* and *ulcus-carcinoma ventriculi* respectively, shows 4 times as high a percentage figure for increased diastasuria among the duodenal-ulcer cases as among the gastric-ulcer or -carcinoma cases — 17 and 4 %. Certainly the difference is statistically only probably significant (Table 4 c), but it appears to call for a discussion.

Table 4 d and e.

Diastasuric Conditions in the 87 Cases Diastase-tested Immediately After Operation (84 Billroth II and 3 Billroth I Cases):

<i>Duodenal Ulcer</i>		d)	<i>Gastric Ulcer or Carcinoma</i>	
<i>With Pancreas Involvement</i>			<i>With Pancreas Involvement</i>	
512 or higher .	3 cases = 14 %	} 19 %	1 case = 8 %	} 17 %
256	1 „		1 „	
< 256	17 „		10 „	
	21 cases		12 cases	
<i>Duodenal Ulcer</i>		e)	<i>Gastric Ulcer or Carcinoma</i>	
<i>Without Pancreas Involvement</i>			<i>Without Pancreas Involvement</i>	
512 or higher .	4 cases = 19 %	} 42 %	1 case = 3 %	} 9 %
256	5 „		2 cases	
< 256	12 „		30 „	
	21 cases		33 cases	

Pancreas involvement is evidently not responsible for the difference in these two groups, as is to be seen from Table 4 d and e. What, then, can be the cause of the higher frequency of increased diastasuria among the duodenal-ulcer cases compared with the gastric-ulcer or -carcinoma cases. The author is of the opinion that this difference may very well be accounted for by a pancreatic duct lesion that has arisen at the mobilization of the duodenum. At resection for ulcer or carcinoma of the stomach such mobilization is as a rule not so extensive. In cases of duodenal ulcer (with or without shrinking processes) on the other hand, whether the pancreas is involved or not, the duodenal mobilization is often

more extensive with increased risks of lesions to the duct of Santorini. In favour of this mode of origin there also argues the fact that there was no immediate postoperative diastase rise in any of the 6 cases of resection for exclusion.

As definite conclusion it may doubtless be said that although statistically significant figures cannot be produced, the analysis of the cases diastase-tested immediately after the operation corresponds well with the hypothesis that duodenal mobilization with lesion of the duct of Santorini is an essential cause of acute pancreatic reactions in gastric resections.

In the material examined here the operative intervention (Billroth II in 130 cases, Billroth I in 4 cases, and resection for exclusion in 13 cases) has provoked a pancreatic disturbance that has manifested itself as a raised diastasuria in 13 cases, *i. e.* 9 % of the total. Probably these 9 % represent a minimum figure, for daily tests were not made during the patients' whole stay in hospital and small disturbances of the pancreas do not invariably give rise to an increased diastasuria in the postoperative course, partly in consequence of the relative starvation regime under which the gastric-resection patients stand during the first 24 hours after operation.

As regards the intensity of the acute pancreatic affection a study of the 13 cases yields the following result. In 6 cases it was so mild that it did not give any reliable clinical signs beyond the increased diastasuria. In 2 cases it gave moderate clinical symptoms from the upper part of the abdomen and in 5 severe clinical symptoms. In 2 of these last 5 cases the pancreatic affection had a fatal issue.

One of these 5 cases is the case referred to on page 6—9 (Jn. no. 812/1943). The other, a man aged 46 years (Jn. no. 326/1946), was operated upon for a callous duodenal ulcer that penetrated to the pancreas. He died 3 days after operation under symptoms characteristic of shock. His highest diastatic index was 8,192. Autopsy disclosed pronounced changes in the abdomen of an acute pancreatic affection type. The author had no opportunity of making a duct-anatomical investigation to ascertain the lesioning mechanism. In the third case with serious symptoms, a 30-year-old man (Jn. No. 23/1948), a pancreatic fistula developed after an abscess, secondary to postoperative pancreatic affection, had been drained 19 days after the resection. The diastatic index was elevated the first three days after operation — gastric resection according to Billroth I — with the highest value of 8,192 the first 24 hours after operation. The patient's stay in hospital was long, altogether four months. In the fourth case, a man of 55 years (Jn.

no. 2579/1944), with an immediate postoperative diastase rise that lasted 7 days, the operating surgeon had ligated a "probably accessory" duct. This duct could be sounded in towards the pancreas; its secrete was not bile-pigmented. A high-grade transitory jaundice and affected general condition set in immediately after the operation. The patient was discharged two months after operation and was re-admitted seven months later for incision of a subhepatic abscess on the right-hand side. In the fifth case, a man of 47 years (Jn. no. 3279/43), the diastasuria was not registered immediately after operation but first later on, showing a highest value of 1,024 and a diastase rise for seven days in succession. Ten days after the operation an incision was made for subphrenic abscess, secondary to acute postoperative pancreatic affection. The patient was discharged healed 3 months after operation.

The cause of the above-reported mild or severe acute pancreatic complications after gastric resection cannot, of course, be elucidated in all the individual 13 cases. The study of the 87 cases diastase-tested immediately after operation disclosed certain points indicating that injuries to the duct of Santorini frequently underlie the acute pancreatic complications registered just after operation. In 2 of the 13 cases with acute pancreatic affection contained in the material a ligature had been applied to a pancreatic duct — for a certainty the duct of Santorini in one of the cases — at the duodenal mobilization, with immediate postoperative acute pancreatic affection as a result.

How Can Postoperative Pancreatic Reactions Be Most Reliably Avoided at Gastric Resections?

A rule of primary importance is to avoid as far as possible injuring the pancreatic parenchyma during the operation. If the ulcer penetrates to the pancreas, it is expedient to cut through the gastric and duodenal wall peripherally and round the ulcer so that on the resected specimen the ulcer then appears as a round hole with somewhat sclerotic edges. After this procedure it is easy to excise any edges of mucous membrane that may be left on the pancreas. Any subsequent treatment of the ulcer-base should be avoided: (1) it should not be excised, (2) it should not be burned or coagulated with diathermy. In cases where the carcinoma has penetrated to the pancreas it is clear that the surgeon must act as radically as possible and not shun resection of pancreatic tissue. In that case the defect must be provided for effectively with unabsorbable suture material and in such manner that no duct injury is caused. The pancreatic duct in the

body-tail region often lies, according to the author's duct-anatomical investigations, cranio-ventrally in the cross-section of the pancreas. In many cases it may be impossible to avoid an injury to the principal duct. In view of such a possibility it is safer to perform a transverse resection of the pancreas and occlude the two stumps of the pancreas with duct ligature and interlocking mattress sutures. According to PERMAN (1948), this is possible without lesioning the splenic vessels. Possibly a resection of the peripheral part of the pancreas plus a splenectomy may be performed. At the Surgical Clinic of Lund STRÖMBECK carried out this operation in 1948 with good result in conjunction with an abdomino-thoracal total gastrectomy for carcinoma. In cases where there is doubt as to whether carcinoma or ulcer is present, a test excision and immediate microscopical examination may be decisive for the operative technique.

An ulcer-base left on the pancreas must be carefully examined to make sure that a pancreatic duct does not terminate in it (bear in mind that at the operation the pancreas is in a state of quiescence and that the pancreatic juice is colourless, provided it is not pigmented with bile on account of bile reflux). A little sulphonamidepenicillin in the form of powder can be placed in the region of the ulcer-base if any anxiety is felt as to a possibly existing infectious agent. (The HCl values in the stomach!)

If the operating surgeon frees the duodenum without opening its lumen, it is of great importance to register the course of the gastro-duodenal and the sup. pancreatico-duodenal artery. Probably the posterior wall of the duodenum can be released down to the point at which these vessels cross the posterior side of the duodenum. In 10 cases examined, the author has found that this point of decussation has consistently lain on an average 3.9 cm. (2.5—5 cm.) from the pylorus and that the distance from it to the duct of Santorini and the lesser papilla has averaged 4 cm. (3—5 cm.).¹

In duodenal ulcer the operating surgeon is in the author's opinion bound to mobilize the duodenum with open stump. Before this is done the pars descendens is mobilized by KOCHER's method and an opening made to the bursa omentalis between the transverse colon and the major curvature of the stomach. These procedures

¹ Occasionally the distance pylorus—pap. minor and pylorus—pap. major respectively can be rather short in normal cases, 4 and 6 cm. respectively (CLAIRMONT).

make it easier to determine by palpation whether resection according to Billroth II or I or else resection for exclusion should be undertaken, and they do not have an injurious effect on the duodenum and the nutrition of the pyloric antrum region. Mobilization is undertaken towards the ligamentum hepato-duodenale, great watchfulness being necessary in troublesome cases in view of the possibility of the common bile-duct having its course here through scar tissue. The duodenum is opened antero-transversally. The ulcer region, the greater papilla (Vater's) and the lesser papilla situated cranio-ventrally to it are palpated by a finger inserted into the duodenum (change of gloves in carcinoma cases!). With this orientation a good idea is obtained about the possibility of separating the duodenum from the pancreas surface without risk of duct lesion. The ulcer-base is left undisturbed on the pancreas, the posterior wall of the duodenum is released from the pancreas to the necessary extent without coming into contact with the region of the lesser papilla. In many cases it is necessary to be content with a short, free posterior duodenal wall of half a centimetre or less. If in these cases the invaginating sutures are applied in the longitudinal direction of the duodenum (instead of transversely) it will be found that reliable invagination is nevertheless obtained (STRÖMBECK).

The lesser papilla may be missing, according to KEYL in 4 % of the cases. In other instances it may be difficult to discover, and this even at autopsy. It has several times happened that the author has been unable to palpate this papilla during his gastric operations. In such circumstances the duodenum must not be detached from the pancreas for a longer stretch than that there remains a distance to the greater papilla of at least 3 cm., especially in a ventral direction. A large palpable lesser papilla does not *always* signify a functioning duct of Santorini and the absence of a palpable lesser papilla does not always mean the absence of a functioning duct of Santorini. Data in the literature (*e. g.* SOBOTTA) as well as the author's experience argue in this direction. The author, however, cannot submit any exact figures.

BOHMANSSON makes a very brief reference to the risks of pancreatic duct lesion in gastric resection, and so does PERMAN. The former had injured the duct on only one occasion in 1934. That this occurred so rarely must to a large extent depend just on the thorough, innocuous mobilization by KOCHER's method and the ample detachment towards the hepato-duodenal ligament

recommended by BOHMANSSON. By this procedure the duodenal mobilization will be least extensive ventrally, just in the region in which the duct of Santorini runs on its way from pancreas surface to duodenal lumen.

In the ordinary handbooks on surgical and operative technique the risk of coming into contact with Santorini's duct at duodenal mobilization are not mentioned at all or only very shortly.

If there is a suspicion of lesion in any form to the pancreatic duct (the ulcer-base left behind penetrates deeply into the pancreas, for instance), or if the invagination of the duodenal stump appears uncertain, the abdominal cavity should be drained with a tube, care being taken that the tube is not placed so that it has direct contact with the suspected region but so that it only passes the latter at the side. In the present material of 147 cases recourse to drainage has been had in 22 cases, *i. e.* 15 %.

The directions outlined above may seem rather rigorous, but they must be so if injury to pancreatic tissue and ducts is to be avoided to the greatest possible extent. *On most occasions it is admittedly harmless to ligate the duct of Santorini, but at the moment of operation the surgeon cannot know how matters stand in this respect and at a later point knowledge of this kind is of little benefit.* If the pancreatic duct system has been injured in some way at operation, the surgeon has several means of improving the situation for the patient, *e. g.* by drainage. Should the injured duct be of large calibre, there is more than one way by which it can be implanted in the duodenum.

There is as yet no sure method of deciding whether an injured duct of Santorini is the sole or main efferent channel of the pancreas parenchyma. In a number of cases, however, some guidance can certainly be obtained by injecting into the injured pancreatic duct, *in the direction of the tail of the organ*, a saline solution tinged with methylene blue. If it is then found that the injected fluid is discharged through the greater papilla, Vater's, into the duodenum, this signifies that there is a functional duct anastomosis to Wirsung's system and a silk ligature may be applied without risk to the divided duct. If the methylene blue fluid is not discharged out of the papilla of Vater, an X-ray examination after injection of a contrast agent of the perabrodil type can doubtless give considerably better duct-anatomical information and hence a more reliable guide for the continued surgical procedure if the radiogram is taken while injection is going on and with a light

injection pressure, there being reason to assume that the contrast medium is apt to diffuse out into the pancreas parenchyma and give radiograms that are difficult to interpret. SCHWARZ's statement that the head of the pancreas is hammer-shaped if the duct of Santorini is present and tongue-shaped if it is absent must, in the author's opinion, be taken with great reservation if the observation is to be used as a ground for any extended duodenal mobilization in an individual case.

The author's investigation has accordingly shown that there are risks of lesioning the pancreatic ducts — especially the duct of Santorini — at duodenal mobilization for resections of the Billroth II and I type. It is however the author's definite opinion that these risks are not so great as to justify a higher recourse to resections for exclusion by Finsterer's method than has been the case during the last five years (1943—1947) at the Lund Surgical Clinic (19 among 180 cases = 10.6 %), provided all the precautions outlined above by the author are taken to save the pancreatic tissue and its ducts.

Summary.

Acute pancreatic affections in connection with gastric resections are not uncommon. In a material of 147 gastric resections at Lund tests of the postoperative urinary diastase show that acute pancreatic affection occurs in at least 10 % during the postoperative course. In 6 cases the pancreatic affection was subclinical and manifested itself only as an increased diastasuria, in 2 cases it gave moderate clinical symptoms and in 5 severe ones. In 2 of these 5 cases the acute pancreatic affection was the cause of death.

The etiology of acute pancreatic affection following gastric resection is not uniform. The author enumerates the chief etiological factors, and advances reasons for considering that duct injury arising at the duodenal mobilization is an important factor to take into account and one that is often overlooked or disregarded. It is the author's earlier duct-anatomical investigations together with the present studies which provide examples of and reasons for the accuracy of this view.

The duct of Santorini is especially exposed to the risk of lesion at the duodenal mobilization owing to the course of the duct to the duodenal lumen ventrally in the head of the pancreas and

orally to the greater papilla. If the duct of Santorini is the sole or main efferent channel of the pancreas parenchyma, which it is in about 10 % of the cases, the consequences may be deleterious for the patient if the duct is injured or ligated at the duodenal mobilization.

The author therefore recommends that in ulcer *duodeni* the duodenal mobilization should always be effected with open stump and first when the operating surgeon has definitely determined the position of the greater and lesser papilla respectively by palpation with a finger inserted into the duodenal lumen. The lesser papilla may be difficult to palpate, at times impossible (it is absent in 4 % of the cases). In spite of this the duct of Santorini may be well developed. In such cases the detachment of the duodenum from pancreatic tissue must not be done to a greater extent than that there is an intervening space of at least 3 cm. to the greater papilla, especially in a ventral direction where the duct of Santorini usually opens into the duodenum.

If a lesion of the pancreatic duct has been inflicted, the nature of the injured duct can probably be determined while the operation is in progress, in a number of cases simply by injection of methylene blue into its stump, in other cases by X-ray examination while contrast medium is being injected into the injured stump. With knowledge acquired in this way of the duct anatomy in the individual case the measures taken by the surgeon as regards the duct lesion will be more adequate.

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Banti's Syndrome with Hematemesis as a Predominating Symptom Treated by Splenectomy.¹

Report of Two Cases.

By

ROLF GRØNN.

It is a long ago established fact that the so-called *Banti's disease* is not a separate disease entity. The clinical picture comprises a number of diseases of the hepato-lieno-portal system, conditions which cannot be separated and the etiology and pathogenesis of which are obscure. The term *Banti's disease* has, therefore, been replaced by the term *Banti's syndrome*, which applies to a group of diseases.

DAG RIIS (1946) has given an excellent survey of the modern connection of *Banti's syndrome*.

The *diagnostic criterions* in *Banti's syndrome* are vague, and are partly of a positive, partly of a negative nature. The *positive* criterions are: splenomegaly, usually associated with secondary anemia, leukopenia, and thrombocytopenia. However, hematemesis with an associated melena may be the predominating feature. Furthermore, certain forms may display a moderate and reversible ascites, which is a stasis phenomenon indicating an advanced stage of the disease. The *negative* criterions are: exclusion of all other known causes of splenic enlargement, *e. g.*, leukemia, lipoidoses, lymphogranulomatosis, hemolytic icterus, acute and chronic infections, etc.

¹ Adapted from a lecture held at a meeting of the Surgical Society, Oslo, Febr. 23rd 1948.

During the recent years American investigators have shown that *Banti's syndrome* is associated with an increased portal pressure. Normally this pressure is low. As concerns the *pathogenesis* the American view is at present generally adopted. According to this view the enlargement of the spleen is caused by the increased portal pressure, which is assumed to be a result of some obstruction in the portal circulation from porta lienalis to the union of the hepatic vein with the inferior vena cava. The most common cause of obstruction is thrombosis of the splenic vein, while next common is probably some congenital malformation.

In *Banti's syndrome* the spleen exerts an inhibiting action on the bone marrow, and this explains the thrombocytopenia and leukopenia — thus the term “splenogenic bone marrow inhibition”.

The cause of the hematemesis is rupture of varicose veins in the esophagus or in the cardiac portion of the stomach, where the portal circulation communicates with the common venous circulation via the *venae gastricae breves* and *vena coronaria ventriculi* (cf. fig. 1).

When there is obstruction of the splenic vein the blood stream must be conveyed via the *venae gastricae breves*. These as well as the esophageal veins will consequently become dilated. In cirrhosis of the liver it is estimated that about 90 per cent of the blood of the portal system cannot pass the liver, but must be conveyed via the collateral circulation just described.

The treatment for *Banti's syndrome* is usually *splenectomy*. The prognosis by this operation is worst in the cases when the liver is involved. Splenectomy entails a serious risk, and not a few patients die shortly afterwards, according to BERNTH and HAGEN up to 20 per cent. The prognosis is far better if the patient can be operated on before there is involvement of the liver, preferably before gastric-intestine hemorrhages have occurred. The *ascites* may respond favourably to splenectomy because of the splenic circulation being shut out from the portal circulation. The splenic circulation is stated to constitute one third of the portal circulation. The *hemorrhages* respond favourably in up to 50 per cent. Even if the pathological circulation can be eliminated, however — as by splenectomy in the case of thrombosis of the splenic vein — the varicose veins may persist, and may, even for many years, give rise to repeated hemorrhages upon exertion. Further, it should be remembered, that even after an apparently successful

operation a thrombosis, as present in the splenic vein, may progress, and thus — besides the gastric-intestine hemorrhages — give rise to thrombosis of the main branch of the portal vein and mesenteric thrombosis with gangrene of the intestine. However, splenectomy is recommended, because the danger is greater if the spleen is not removed.

Much stress is laid upon the *sternal* smear as to whether the patient should be operated or not. Indication for operation is a highly cellular marrow with increased erythrocytopoiesis (mitoses, etc.).

The blood picture after splenectomy clearly illustrates the elimination of the splenogenic inhibiting action on the bone marrow. Following splenectomy the number of leukocytes and thrombocytes increases, and this feature alone is a criterion to the effect that the operation has been advantageous. Bleeding time, coagulation time, and osmotic resistance are not affected by splenectomy.

Case 1. Mrs. K. T., aged 46, first time admitted to Halden Municipal Hospital in October 1942, and remitted in July 1943, both times for menorrhagia. Curettage was performed and the pathologist's report (Dr. REIDAR EKER) both times read "hyperplastic uterine mucosa with circulatory disturbances". Otherwise the findings on physical examinations were essentially negative, and it was particularly noted that there was nothing abnormal regarding the abdomen. On December 13th, 1945, she was admitted to the hospital for the third time, this time owing to *hematemesis*. From the case notes it is evident that she had never suffered from dyspepsia, until she 14 days prior to the last admission experienced slight hunger pains in the epigastrium. The day prior to admission she suddenly felt an oppressing sensation under the tip of the sternum, and immediately after blood came pouring through the mouth. The physician summoned decided not to move the patient and she was, therefore, not admitted to the hospital until the next day.

On admission the patient was very pale, exhausted, and dizzy. The pulse rate was 92, regular, the quality normal. The temperature (ax.) was 37.9° C. Blood pressure 185/105. The heart and lungs were normal. *Abdomen:* The liver could be palpated 2 cm below the right costal margin, and the spleen could be felt like a goose-egg-sized protrusion below the left costal margin, under which it disappeared. The consistency was firm. Ascites could not be demonstrated. Shortly after admission she received 500 ml of citrated blood. The next day roentgenograms were taken of the stomach and duodenum. These showed normal conditions except for the spleen, which made a crescent-like impression in the gastric contrast.

Thrombocytopenia, leukopenia, and slight secondary anemia per-

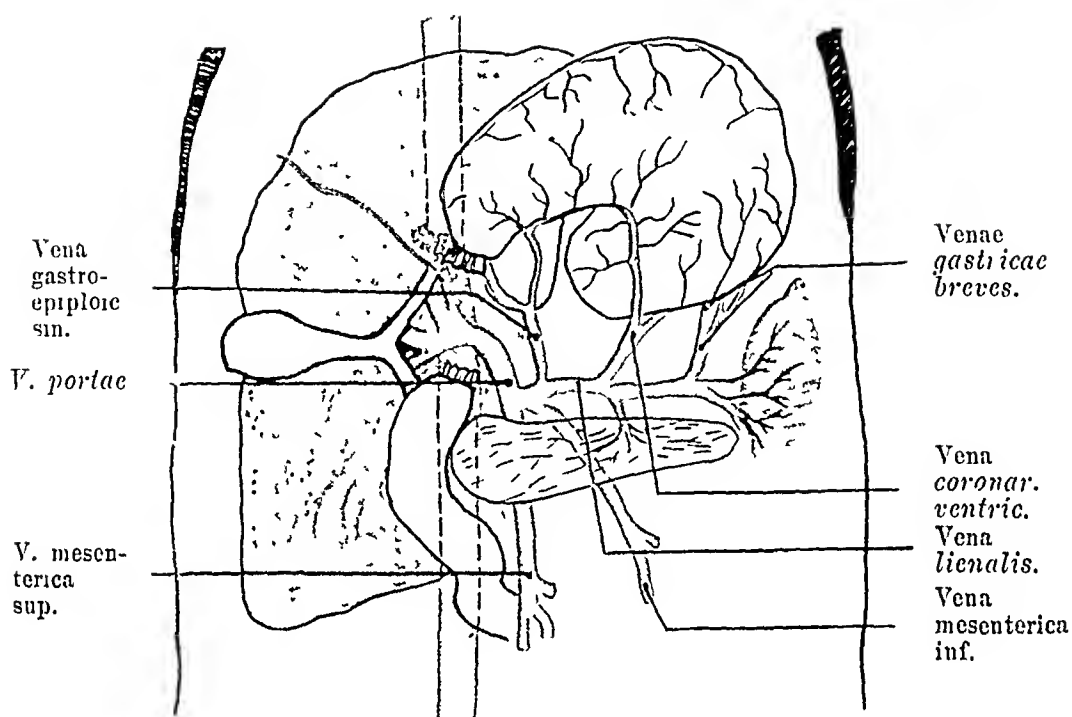


Fig. 1. Diagram showing the hepato-liceno-portal venous circulation.

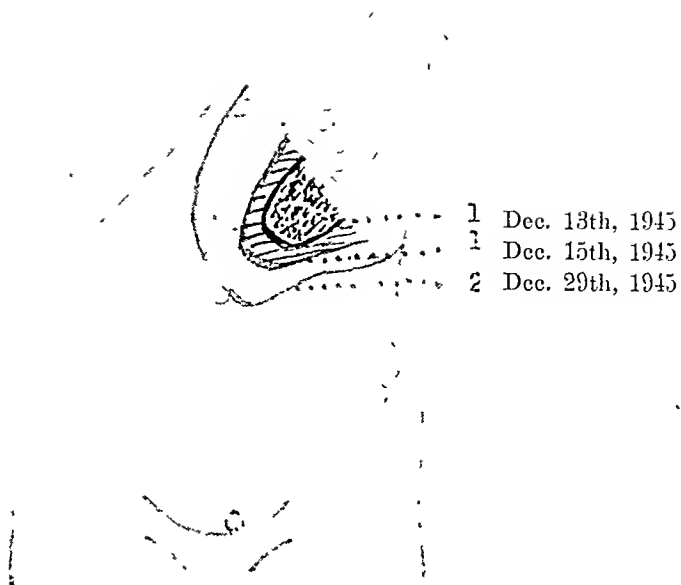


Fig. 3. Diagram showing the varying size of the spleen, December 1945 when the patient was admitted owing to hematemesis.

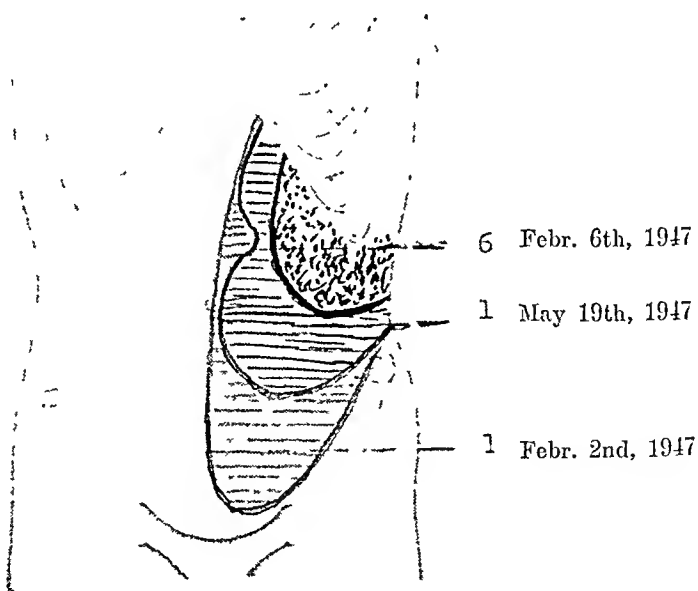


Fig. 6. Diagram showing the varying size of the spleen.



Fig. 2. Roentgenogram showing esophageal varices.



Fig. 4. The roentgenogram fifteen months after the operation, showing marked regression of the esophageal varices (cf. Fig. 2).

GRØNN: Banti's Syndrome Treated by Splenectomy.

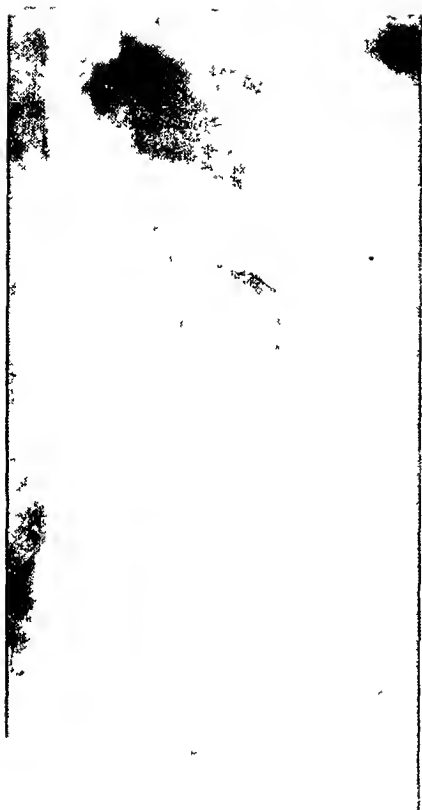


Fig. 5. Roentgenogram showing esophageal varices.

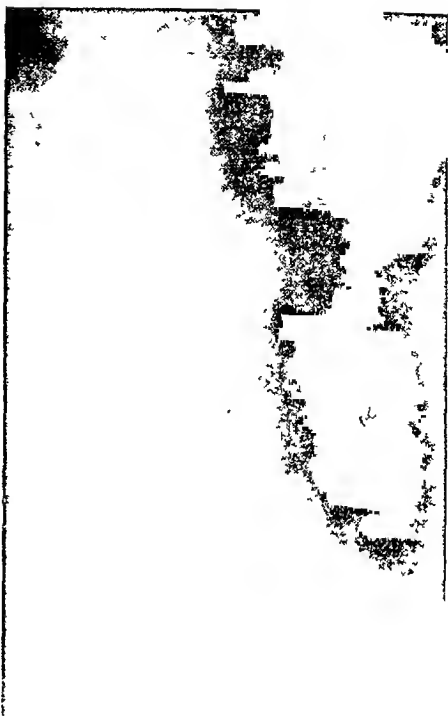


Fig. 7. The roentgenogram four and a half months after the operation showing marked regression of the esophageal varices (cf. Fig. 5).

sisted on repeated examinations. These and some other findings in the blood will be more closely considered in tabular form in a later paragraph. However, some laboratory data are mentioned here:

The following tests were *negative*: MEINICKE, WASSERMANN, TAKATA, GÖTHLIN, PIRQUET.

Normal data were obtained as to osmotic resistance, sternal puncture (hyperplastic marrow), reticulocytes, icterus index, prothrombin time, differential count, urine, electrocardiogram, roentgenograms of femur and humerus.

Fractional determination of the serum proteins showed:

Total protein	6.5	per cent	
Albumin	4.0	»	»
Globulin	2.5	»	»
Alb.-glob. ratio	1.6	»	»

Roentgenograms¹ of the esophagus (Dec. 14th) showed irregular jagged contours, and small up to pea-sized areas of translucency could be seen in the contrast R: Esophageal varices (Pl. I, fig. 2).

The benzidine reaction in the stools was positive during the first eight days of the hospitalization period, but was negative later on. The temperature was normal most of the time, although the patient was subfebrile now and then. The enlarged spleen showed a further gradual increase during this period (cf. Fig. 3).

The condition was diagnosed as "Banti's syndrome — *Splenomegalia thrombopenica*".

Splenectomy was obviously indicated, but the patient was temporarily transferred to St. Joseph's Hospital for internal medical observation and treatment (Jan. 1st 1946) where she stayed for two weeks. During the ensuing months she felt well, could take any kind of food, and no hematemesis occurred. In June, 1946 Dr. BRUSTAD, who attended the patient during this period, thought her condition sufficiently improved to stand a splenectomy and she was readmitted to Halden Hospital on June 16th to have the operation performed.

Examination of the *abdomen* showed that the splenic enlargement was less marked than on the previous stay, the spleen now extending distally to about 2 cm above the umbilical plane, and medially to about 2 cm to the left of the midline.

The consistency was firm, the surface smooth, and the edge evenly rounded. The liver could not be palpated. There was no ascites. Some small petechiae could be seen on the left upper arm. The bleeding time on this occasion was 14 minutes.

On June 26th, 1946, a *splenectomy* was performed (GRØNN) with the patient under scopolamine-morphine-ether anesthesia. The incision was made through the left rectus muscle and extended from above the costal margin to the umbilical plane. From the lower angle of this incision the wound was widened by a 8 cm long incision in a transversal direction to the left. The bleeding during this procedure was apparently more marked than usual. A bluish-white-violet, firm, smooth spleen

¹ Interpretations by the roentgenologist Dr. SVERRE STRAND.

Case 2. K. L., male aged 25, who stayed in Halden Municipal Hospital from Febr. 2nd, to March 27th, 1947. The case was diagnosed as "*Banti's syndrome, Hematemesis (thrombosis of the splenic vein?)*".

The case notes show that the patient had had an enlarged spleen since he was two years old. At the age of five he was operated on for acute appendicitis. In 1933 — 11 years old — he vomited blood on several occasions, and in 1937 he had a single hematemesis following some physical effort. Since then he was quite well until 1942 when the stools became tarry, and he was confined to bed for three weeks. He was then admitted to the Medical Department A of the University Hospital, Oslo, where he stayed for thirteen days. The condition was diagnosed as splenomegalia. Signs of esophageal varices were present, and examination of the blood revealed leukopenia, thrombocytopenia, and prolonged bleeding time (15 minutes). There was also a tendency to bleeding in the history. Sternal smears showed an increased number of megakaryocytes, but the marrow was otherwise normal. Gaucher cells could not be demonstrated. The benzidine reaction in the stools was positive. Blood pressure 130/85. Slight secondary anemia was present.

Since the stay in the University Hospital no hemorrhages occurred, and he felt well. He had never had dyspepsia or fractures. However, two days prior to the admission to Halden Municipal Hospital (Jan. 31st) he suddenly experienced a stinging pain in the epigastrium shortly after supper, and shortly afterwards he vomited large quantities of gastric contents and dark red blood. The pain then ceased. The next day he felt rather exhausted and stayed in bed. The following night he had two more hematemeses, and the physician summoned had him admitted to the hospital as an emergency case.

The *physical examination* showed a patient highly emaciated in the face and on the upper arms, a feature which strongly contrasted the barrel-shaped distended lower thorax and the greatly — particularly in the flanks — distended abdomen. The pulse was 100 beats per minute, regular, good. Temperature (ax.) 36.2° C. Blood pressure 105/65. The reflexes were normal. There were no edemas or palpable glands. Some brown-pigmented patches were seen on the dorsal aspect of both legs. The heart and lungs were normal.

Abdomen: The spleen was enlarged and extended distally to the umbilical plane and medially a little beyond the midclavicular line. The consistency was firm and the surface smooth. The liver could not be palpated. No ascites. The urine was normal. No icterus. No information concerning whether there had been a tendency to bleeding or icterus in the family could be obtained from the patient. Roentgenograms of the stomach and duodenum showed that the major curvature was somewhat displaced by the enlarged spleen, but were otherwise normal. Roentgenograms of the esophagus (Febr. 14th) showed a number of round areas of translucency in the contrast and an irregular jagged contour. *R: Esophageal varices* (Pl. II, fig. 5).

Laboratory Data. Thrombocytopenia, and leukopenia, and secondary anemia persisted. On admission the hemoglobin content was 71 per cent. Seven days later it had fallen to 45 per cent. The benzidine reac-

tion in the stools was positive during the first thirteen days of the hospitalization period, but was negative later on. Fractional determination of the serum proteins showed a total protein of 6.1 per cent, albumin 4.2 per cent, globulin 1.9 per cent, and albumin-globulin ratio of 2.21. The sternal smear revealed an increased erythrocytopoiesis, but not Gaucher cells. The Pirquet reaction was negative, and so was also the Wassermann reaction. The prothrombin time was 50 seconds. Malarial parasites could not be demonstrated. A differential count was normal. The serum iron was decreased, probably owing to the anemia, and was 53 gamma per cent.

Two weeks after the admission the abdomen was still more distended with definite signs of *ascites*. The icterus index was 14, and the Takata reaction positive (++) indicating *hepatic insufficiency*. The spleen showed a further increase in size and extended to the pelvic aperture. It was firm, but not tender. Ballotement could be felt over its lower pole. Distended veins extending upwards were seen in both groins. No anasarca.

During the hospitalization period he received seven blood transfusions and was otherwise treated by administration of reduced iron, liver extract, and a high protein diet with restriction of salt.

On March 27th, 1947, when the patient was discharged, he still presented a Banti's syndrome including splenomegaly, thrombocytopenia, leukopenia, anemia, involvement of the liver, secondary esophageal varices, and ascites. The ascites, however, disappeared completely. He was not confined to bed during the last days in hospital, and was feeling well.

As to the cause of the disease, nothing definite could be said at this juncture, but thrombosis of the splenic vein was suspected. The condition represented a so-called third stage of Banti's syndrome, indicating that a splenectomy should have been performed long ago. However, owing to the impaired general condition of the patient, splenectomy could not be recommended, and he was, therefore, referred to an internal specialist for further treatment and control.

By the end of April, 1947, Dr. BRUSTAD, who had taken over the treatment, strongly recommended splenectomy, as he thought the patient had improved exceedingly well. Thrombocytopenia, leukopenia, and splenic enlargement, were still present. The splenomegaly, however, was far less marked than on the previous occasions, and the blood, except for the thrombocytopenia and leukopenia, was normal. Dr. BRUSTAD shared our opinion that the spleen ought to have been removed long ago, but he thought that the patient's only chance would be to have the spleen removed even if this involved a considerable risk.

The patient was thus readmitted to Halden Municipal Hospital on May 19th, 1947, in order to have the spleen removed. Regarding his condition, it may be mentioned that he was still thin, but otherwise healthy-looking. There was no ascites, and the liver was not palpable. The enlarged spleen extended medially almost to the midline and distally to the spinous plane (cf. Fig. 6).

The blood pressure was 120/65. The Takata reaction was negative. Icterus index 10. A differential count was normal. Fractional determination of serum proteins: Total protein 8.6 per cent, albumin 5.5 per cent, globulin 3.1 per cent, albumin-globulin ratio 1.77. The remaining laboratory data are considered in tabular form in a later paragraph.

On May 22nd, 1947, a *splenectomy* was performed with the patient under scopolamine-morphine-ether anesthesia (GRÖNN).

The incision was made through the left rectus muscle. It extended from above the costal margin to about 5 cm below the umbilical plane. The spleen was bluish grey, firm, with a somewhat irregular surface and of the size of a bread. It could not be everted, owing to broad, heavy, highly vascular adhesions which fixed it to the following structures: 1) the major curvature of the stomach in a length of 12 cm, 2) pancreas, 3) mesocolon, 4) a 8 cm long portion of the transverse colon extending to the splenic flexure, and 5) the posterior abdominal wall.

Under much doubt it was decided carry on with the obviously very difficult extirpation. Starting from below the gastrocolic and gastrosplenic ligaments were divided, so that entrance was gained to the omental bursa and thus to the splenic pedicle, the diameter of which was about that of a forearm. The splenic vein was completely thrombosed and firm, its diameter about that of a wrist. The pedicle was fixed to the mesocolon, transverse colon, and the tail of the pancreas by broad adhesions. Starting at the lower aspect, individual portions of the pedicle were carefully ligated as close to the splenic hilus as possible in order to facilitate the further manipulation. Two ml of adrenalin were injected into the spleen which was thus reduced to one third of its original size. This was of some aid, but detaching the spleen from the adjacent structures was all the time very difficult and associated with troublesome hemorrhage owing to the highly vascular adhesions. The patient received 500 ml of citrated blood during the operation. The liver was a little smaller than normal, probably slightly atrophic. The color was brownish red, the surface smooth, and the consistency not very firm. The lower edge was sharp. A biopsy specimen from the liver would have been of great interest, but was not taken, as this would have prolonged the operation. No ascites. Drainage of the splenic bed was accomplished by means of two cigarette drains, and the various layers of the abdominal wall were then closed around the drains.

The patient stood the operation well, and the postoperative course was uneventful. The removed spleen, which was now only one third of its original size, weighed 1.5 kg. The operation was technically very exacting and partly very dramatic owing to the great risk of fatal hemorrhage. As mentioned, a *thrombosis of the splenic vein* of great dimensions was present. P. A. D.: *Spleen with fibrosis and hemorrhage* (EKER).

During the first four postoperative weeks he was running a temperature which varied from 38 to 38.5° C — as did the first patient. But the general condition was remarkably little impaired despite the increased temperature. He left the bed four weeks after the operation, and was

Table 2.
Laboratory Data.

Date	Before the operation				Operation	After the operation	
	Feb. 10	Feb. 18	Mar. 5	May 21	May 22	May 23	Sept. 29
Hb, per cent	55	46	74	90			96
RBC, millions	2.5			4.7			5.0
WBC	5 600	1 600		2 200	4 200	29 000	12 100
Thrombocytes	136 250		86 000	66 000	177 000	233 000	488 000
Bleeding time	3.5 min.	4 min.	4 min.	6.5 min		2 min.	2 min.
Coagulation time	3 min.	3 min.	3 min.	4 min.		3 min.	3 min.
Sedimentation rate...	9 mm	8 mm	5 mm	8 mm			22 mm
Takata		++		neg.			
Serum iron gamma per cent		53					

The benzidine reaction in the stools was positive during the first thirteen days of the hospitalization period, but was negative later on.

← Ascites →

discharged on July 3rd, 1947, *i. e.*, six weeks after the operation, feeling well.

On a *control examination*, Sept. 29th, 1947, *i. e.*, more than four months after the operation, the patient stated that he never had been feeling so well in all his life, and had gained 6 kg in weight. The liver could not be palpated, there was no ascites, and no dullness in Traube's semicircular space. The prothrombin time was 32 seconds. Icterus index 7. Takata negative. Coagulum retraction normal. Blood pressure 130/85. Sedimentation rate 22 (the patient suffered from a cold).

In a letter dated February 1948 — eight months after the operation — the patient states that he is feeling well and healthy, carrying out usual work.

Roentgenograms taken of the esophagus on Oct. 1st, 1947, *i. e.*, about four months after the removal of the spleen, shows *esophageal varices with evidence of regression* (Pl. II, fig. 7).

Table II shows the findings in the blood before, during, and after the splenectomy.

Comment.

The two cases of Banti's syndrome reported here had the following features *in common*:

1) Both were admitted to the hospital as emergency cases owing to a severe *hematemesis*.

2) The case of the hematemesis in both instances was *esophageal varices*.

3) *Banti's syndrome* was responsible for the varices in both instances.

4) In both cases there was a certain — although not very marked — tendency to bleeding.

5) In both cases the splenectomy was followed by an absorption fever of four months' duration.

6) In both cases the splenogenic inhibiting action on the bone marrow disappeared following the splenectomy, which was also followed by a regression of the esophageal varices. In other words the intended purpose of the operation was fulfilled.

The two cases *differed* in the following aspects:

The first case, a 46-year-old woman, was operated on at an *early stage* of the disease, *i. e.*, before the onset of ascites and more extensive parenchymatous changes of the liver, and while the operation was still technically simple, whereas the other patient, a 25-year-old man, was operated at a *very late stage* of the disease, when ascites and clinical signs of hepatic insufficiency had developed indicating that a secondary cirrhosis of the liver of the Laënnec type was imminent.

Further, the second patient had *thrombosis of the splenic vein* as found during the arduous operation, and which explained the syndrome, whereas in the first case no primary cause could be found. However, it cannot be excluded that the splenic vein has been thrombosed in this patient too, even if a thrombosis could not be demonstrated.

As to the chance of complete recovery nothing definite can be said, except that the prognosis is no doubt better in the first of the two cases.

The fact that the esophageal varices in both cases showed signs of regression (in case 1: fifteen months, and in case 2: four and a half months after the operation) indicates a favourable prognosis. However, the varices represent a constant danger as long as they persist.

Summary.

The author reports two cases of Banti's syndrome. Both were admitted to the hospital owing to severe hematemesis due to esophageal varices as demonstrated by roentgenographie examination.

In the first patient a splenectomy was performed at an early stage of the disease, and here the operation was simple. In the second patient, however, the disease was far advanced at the time of the operation, as indicated by the presence of a transient ascites and signs of hepatic insufficiency. In this case a thrombosis of the splenic vein of huge dimension explained the syndrome.

In both patients the splenic inhibiting action on the bone marrow disappeared as a result of the splenectomy, which also caused a regression of the esophageal varices as shown on the roentgenograms taken before, and fifteen and four and a half months, respectively, after the operation. Both patients are so far healthy and carrying out usual work.

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Hydrocalyx.

By

PAUL RUDSTRÖM, M. D.

More than a century ago, RAYER in France described two cases with intrarenal cyst formations caused by the dilatation of a single calyx. In one there was an uncomplicated cyst formation; in the other a large number of concretions had formed in the cavity. The formation of calculi was considered to be secondary. It is only in recent years, however, that dilatation of a single calyx has aroused any great diagnostic or clinical interest. Several renal changes, more or less similar in character, have been described under different names. Thus WATKINS (1939) reported a case of isolated dilatation of the calyx which he called hydrocalyx. PRATHER (1941) suggested the term calyx diverticulum, whereas QUINBY and BRIGHT (1935) and ENGEL (1947) used the designations pyelogenic cyst formation and calyxectasia respectively.

The cause of an isolated dilatation of a calyx is an impediment in the flow of the urine from the calyx to the renal pelvis. We know from contrast examination of the urinary tract that anatomical conditions in the calyx and the renal pelvis are subject to considerable variations and that long narrow infundibula are often found that can easily be envisaged as the site of a mechanical impediment. A definite pathological process, such as stricture on the grounds of inflammatory lesions (HYAMS & KENYON 1941) concretions, etc. may also be found as the cause of a dilatation of the calyx. Nevertheless, WATKINS and WINSBURY-WHITE (1939) reported cases in which no obstruction could be demonstrated. They were of the opinion that in such instances a spastic

contraction of the musculature in the infundibulum was the causative factor. WATKINS reserves the term hydrocalyx for such cases in which no major anatomical change can be demonstrated in the infundibulum. An incongruity between the width of the infundibulum and the amount of urine which must pass it could give rise to a dilatation of a calyx. The flow of urine varies with the number of papillae which in turn, can vary considerably in number. It is thus easy in the individual case to envisage a large secretion of urine at the same time that the passage between the calyx and the renal pelvis is narrow. PRATHER emphasizes that his cases described as diverticuli of the calyx are identical with the renal changes termed hydrocalyx by WATKINS, whereas BENEVENTI (1943) considers that it is a question of a particular type of cyst formation. In view of the complicated embryological development of the kidney, various types of malformations can readily be envisaged. Individual aspects of the embryology of the kidney can not as yet be considered as established and HARDENHAIN's (1937) theories are in several respects in opposition to earlier assumptions.

The diagnosis of hydrocalyx can only be made after contrast examination of the kidneys. On intravenous urography the cystic cavity of which the hydrocalyx consists is filled with contrast at the same time as the rest of the renal pelvis. The contrast is, however, often seen to remain in the hydrocalyx when the renal pelvis has been emptied. This is due to the difficulty of passage in the narrow connexion between them. In my own cases, as well as in those I have encountered in the literature, the renal shadow was normal in size and contour. The radiological differential diagnosis — which will not be discussed in detail in this connexion — is sometimes difficult. It can be a question of a tuberculous cavity, a true tumour with a calyx dilatation, cystic cystitis or so-called recesses of the renal pelvis (ASK-UPMARK 1929) etc. Finally, it must also be recalled that true intrarenal cyst formations can secondarily penetrate into the renal pelvis. The differential diagnosis between true cysts and such that originate in the renal pelvis can as a rule only be made by means of histological examination of the wall of the cavity. Even microscopical examination can at times fail to give a definite answer, since the transitional epithelium can assume an almost cubic shape through distension of the cystic cavity. On the other hand, the presence of musculature in the cystic wall is considered to be proof of the

genetic connexion with the pelvis. Cysts originating at this site can gradually become entirely detached from their connexion with it and act clinically as true cyst formations, destroying the renal parenchyma and bulging into the surface of the kidney like a tumour formation.

According to the literature, the *treatment of hydrocalyx* has been partly conservative and partly operative. BENEVENTI (1943) described a case in which he was able to arrest the symptoms by means of retrograde dilatation of the constricted area in the infundibulum. This is, however, only possible when a superior calyx is involved. PRATHER made a surgical intervention in three cases in the form of nephrostomy and dilatation following an incision in the kidney. The catheter was left in position for about two weeks and the results were found to be satisfactory. It is probable that nephrectomy has been performed in many cases of cyst formations, particularly where the cavity maintained a lengthy infection of the urinary tract or where the possibility of tuberculosis could not be excluded. Resection of the kidney appears only to have been performed in exceptional cases. In cases reported by Scandinavian writers (ÖSTLING 1934, LJUNGGREN 1938, NATVIG 1941) nephrectomy seems to have been performed whenever it was a question of a surgical intervention.

Three cases of hydrocalyx have been treated during the last three years at the Surgical University Clinic in Upsala. They appear to be of general interest particularly from the therapeutical aspect.

The first case is that of a 46-year-old building labourer who had suffered from dorsal pains for several years before his admission to hospital in 1945. These pains had been interpreted as lumbago and had often forced him to be absent from work. During the last year he had pain of the renal colic type. Examination on admission revealed that there was no infection of the urinary tract and no proteinuria. Renal function was formal. Intravenous urography (fig. 1) showed satisfactory contrast-filling of the renal pelvis and of an excessively dilated major calyx. This contained five concretions. At operation a calyxtomy was performed, with wedge-shaped excision of the renal parenchyma and resulting removal of the concretions. During the intervention the large vessels in the hilus were compressed manually and the process was localized with the aid of radiology. Four deep catgut sutures completely stilled the bleeding. Biopsy confirmed that it was a question of dilated calyx. Intravenous urography at a follow-up examination two years after the operation showed normal secretory conditions. The neck of the excised calyx showed as a small knob (fig. 2).

The second case was a 42-year-old woman who was admitted to hospital for the first time six months prior to operation with a typical attack of pyelitis. The onset was acute with pyrexia and tenderness over the left kidney. There had been no signs of infection of the urinary tract previously. For several years before admission she had suffered from dull and indefinite pains both in the back and the abdomen. Urography revealed an expansile process in the lower part of the left kidney. Retrograde pyelography resulted in contrast-filling of an irregular cavity which was interpreted as an abscess. The examination also revealed colibacilluria but no grounds for suspecting tuberculosis. A tuberculin reaction was negative. No concretions were found. In this case as well calysectomy was performed with wedge-shaped excision of the renal parenchyma. At operation a cicatricial formation was observed on the surface of the kidney, thus facilitating the localization. Biopsy revealed that the cavity consisted of an isolated calyx. Follow-up examination six months after the operation with intravenous urography showed normal conditions. There was no visible deformity of the renal pelvis.

The third patient was a 43-year-old woman who had earlier lived in America. Right-sided nephrectomy had then been suggested on the grounds of recurrent infection of the urinary tract. She was admitted to our hospital in March 1948 with pyelitis and colibacilluria. Intravenous urography (fig. III) showed considerable dilatation of the superior group of calyces in the right kidney and a concretion so large that passage through the narrow neck of the calyx could not be envisaged. Operation was performed in the middle of April and slightly more than one-third of the right kidney was resected. In this case the intervention presented some technical problems since the resection was of such an extent that it had to be made close to the renal artery. The line of resection and the topography are seen from the schematic drawing (fig. IV). The assisting surgeon gripped the renal artery as close to the kidney as possible and it was thus possible to make the resection close to the main trunk without injuring it.

The immediate post-operative course was normal and the patient left the hospital after three weeks. At a follow-up examination six weeks after the operation there was still colibacilluria but the patient was free from subjective symptoms. The infection proved to be sulpharesistant. Intravenous urography showed normal secretory conditions and a normal renal pelvis except that the upper calyx group was lacking (fig. V). The patient was re-admitted after a further four weeks with pyrexia and infection in the operation scar. After incision, plentiful pus was evacuated. It was soon found that a renal fistula was present. The sulpharesistant colibacilluria was treated with streptomycin. The fistula healed spontaneously after three weeks and since then the patient has been free from discomforts.

The three cases described thus had similar renal changes consisting of an isolated cystic dilatation of a calyx, complicated in two of them by the formation of calculi. In one of these cases



Fig. 1. Considerable dilatation of a calyx containing
5 small concretions.



Fig. 2. Intravenous post-operative urography. The
dilated calyx has been extirpated. The arrow indi-
cates the neck of the calyx.

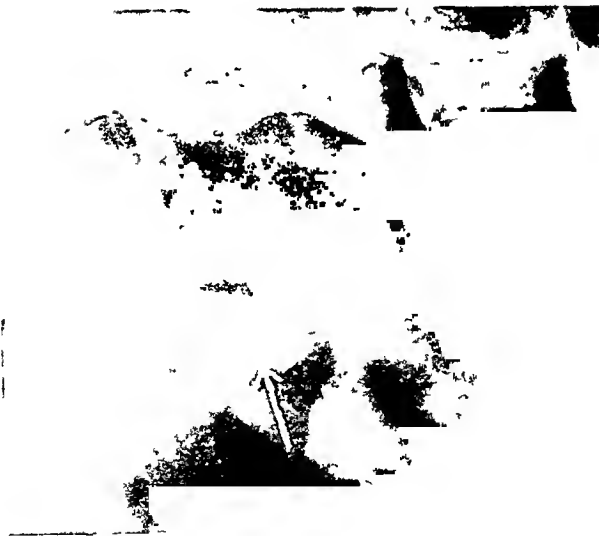


Fig. 3. Intravenous urography. The uppermost calyx is marked dilated. The arrow indicates a concretion.



Fig. 4. The same patient as in the preceding figure. Intravenous post-operative urography. The hydrocortisone has been extirpated.

there was a concomitant infection of the urinary tract. No concretions were found in the third instance, but there was a urinary infection. There was no haematuria in any of the cases. Pain in the lumbar region of a dull, aching nature increasing on exertion appeared to be a common symptom. All three patients received the same surgical treatment, *i. e.* calysectomy and resection of

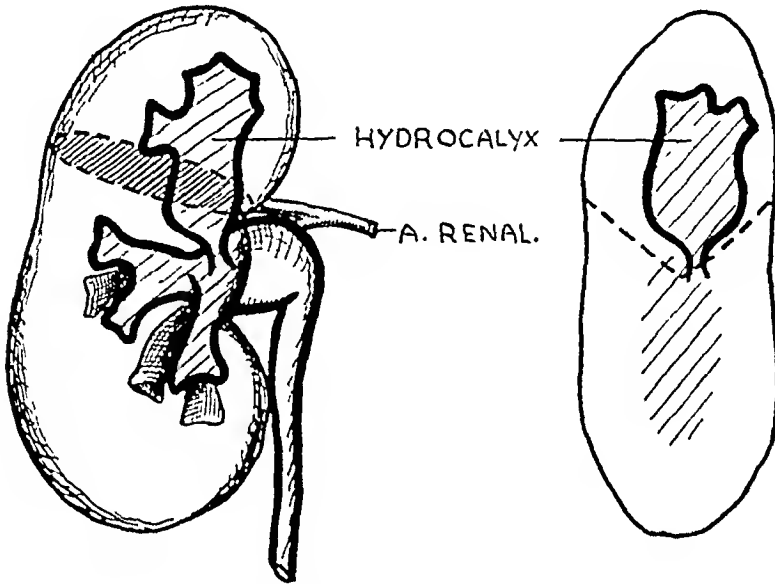


Fig. 5. Schematic drawing showing the anatomical conditions and the incisions in resection of the kidney.

the kidney. The intervention was performed under spinal anaesthesia and the kidney was exposed in the usual way. In one case posterior splanchnic anaesthesia was used. By means of manual compression of the large vessels of the hilus during the operation, bleeding from the parenchyma was controlled and a good survey of the field was obtained.

Ureteral catheterization was performed in connexion with the operation. It is obviously important to keep the passage through the ureter open and thus to lessen the risk of a renal fistula. The immediate post-operative course was free from complications in all three cases. The patients were discharged from hospital after 9 days, 11 days and 3 weeks respectively. The two cases first operated on were examined three and two years after the operation respectively and the urine was found to be normal in both instances. Intravenous urography showed satisfactory renal function and bilateral excretion of the contrast. Both patients were free from subjective discomforts. It was particularly interesting to

note that no hypertension was found at the follow-up examination. This could otherwise be a possible complication since relatively large vascular trunks can become involved in the healing process with a risk of an elevation of the blood pressure through a Goldblatt mechanism. In the third case there was a urinary fistula which nevertheless healed spontaneously.

Resection of a kidney is a minor intervention which has little influence on its function and that appears to be suitable for more widespread use in cases such as those described in the foregoing. This intervention is also recommended by YUNCK & FORSYNTH (1941) for recurring concretions in the same calyx even if no pathological dilatation is present. ENGEL (1947) reported a series of 9 cases in which he performed resection of a kidney without the occurrence of complications. He — as do the two forementioned writers — gives a detailed account of his operating technique. YUNCK & FORSYNTH have also demonstrated by means of animal experiments that this intervention has little deleterious effect on renal function. They point out that diathermy should not be used in this operation but that resection should be performed with a scalpel, since the former method is considered to increase the risk of haemorrhage.

An uncomplicated hydrocalyx is generally no indication for operation, but infection and the formation of calculi can easily occur owing to the malformation. Spontaneous expulsion of the concretion is generally impossible owing to a narrowing of the infundibulum. It is probable that such a narrow passage can gradually become altogether occluded and retention in the dilated calyx can then give rise to pressure atrophy of the renal parenchyma. If any of these complications is present, surgical intervention is indicated. This should, nevertheless, be confined to resection, and nephrectomy should only be performed in exceptional cases.

Summary.

An account is given of three cases of so-called hydrocalyx treated surgically. In two of the cases there was a calculus formation in the cavity. The third patient also suffered from a sulphar-resistant infection of the urinary tract. Operation was performed and the hydrocalyx removed by means of resection of a wedge-

shaped portion of the kidney. The immediate post-operative course was free from complications. A renal fistula occurred in one case after four weeks, but healed spontaneously.

The technique in resection of the kidney is described and this intervention recommended for renal lesions of this type.

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A New Operation for Gastropotosis.

By

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Previously lectures over and demonstrations of this disease formed a considerable part of the medical and surgical education. None of the methods for operative treatment were regarded as satisfactory. ROVSING's gastropexy was most commonly used.

Nowadays one often reads and hears that the disease of gastropotosis is more or less taboo, and many are of the opinion that the condition gives no symptoms. In the last edition of the "Northern Textbook of Internal Medicine", however, KNUD FABER writes: "With few exceptions the gastropotosis amounts to an elongation of the stomach so that its transverse part comes lower down into the belly than usual when the person stands upright. The pyloric part has in many cases not altered in position. The symptoms may be due to such complications as gastritis, constipation, atonia and the like. The sufferings which the gastropotosis involves therefore amount to such dyspeptic troubles as cardialgia, especially just after meals when standing upright, a pronounced anorexia an obstinate constipation and also ordinary fatigue and nervousness. There is frequently a delayed emptying of the stomach and a tendency to atonia."

In his chapter on abdominal atonia KNUD FABER writes that the disease is particularly frequent with the gastropototical "long-stomach". The lower part of the stomach is abnormally distended by the food while the upper part is empty. The food sinks to the bottom because it cannot as under normal conditions be kept evenly distributed in the entire length of the stomach. As a treatment is suggested a counteracting of the underfeeding which is so frequently to be found with these patients.



Fig. 2 Case 3. Before gastropexy.

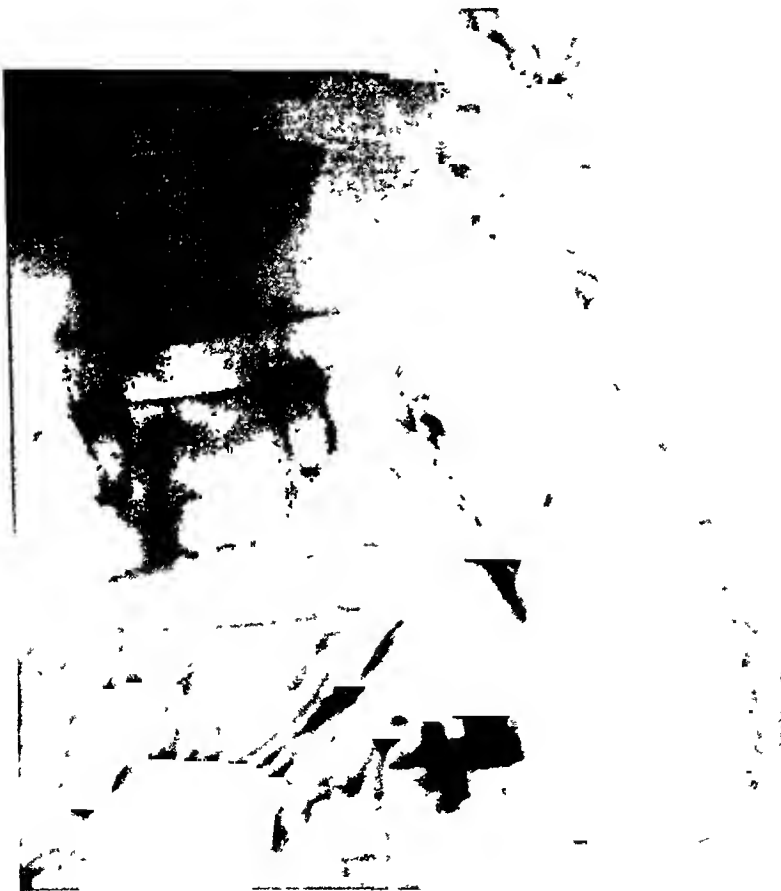


Fig. 3. Case 3. 8 years after gastropexy.

RAABE: A New Operation for Gastroplosis.

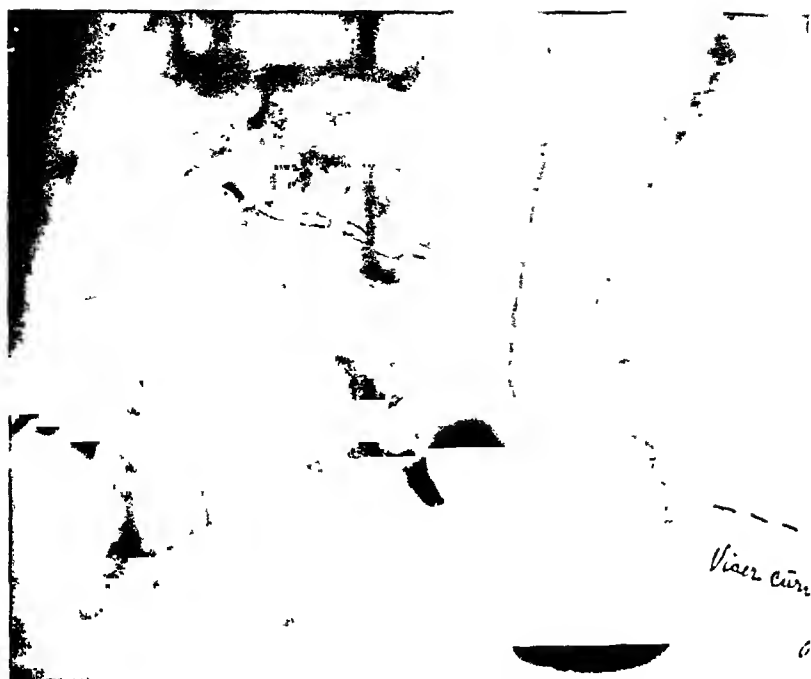


Fig. 4. Case 35. Before gastropexy — — — after.

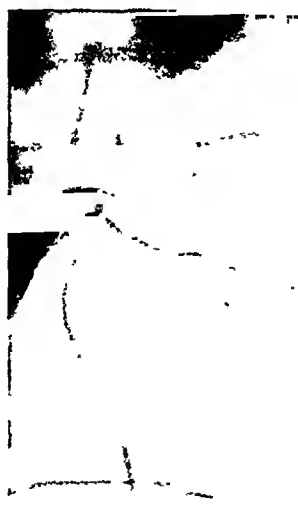


Fig. 5. Case 35. 3 years after gastropexy.



Fig. 6. Case 32. 5 years after gastropexy.

RAABE: A New Operation for Gastropptosis.



Fig. 7. Case 53. $1\frac{1}{2}$ year after gastropexy.



Fig. 8. Case 20. 17 years after gastropexy.

T. KALIMA says in the last edition of the "Northern Textbook of Surgery" about gastrocoloptosis: "With regard to the surgical treatment it appears by critical survey with the stress mainly upon the enduring post-operative results that these amounted to no more than 50 % or even less."

When I permit myself to reopen the question of the treatment of a disease which is in these days so disregarded, I am prepared to meet with protests. I have, however, seen a series of immediate and lasting results of an operation indicated by me — results which still remains today some 18 years after treatment.

The *symptoms* which in my opinion would indicate an operation — apart from the cases in which the X-ray shows a ptosis with *curvatura minor* (according to FABER) situated at least 0.8 inches below the umbilical level are in the first place a considerable emaciation due to anorexia, a severe constipation due to the pronounced bend of the pylorus, a retention of the stomach and troubles immediately after meals when the patient is standing upright.

The reason why the surgical treatment enjoys so little popularity may be found in the fact that none of the indicated methods are satisfactory, because the stomach is not being fastened in its natural position to any fixed organ — which would for ever prevent another sinking down of the stomach. Besides, the suffering is often combined with neurosis and the nervous dyspeptic phenomena which may still exist after an operation: If therefore an operation is attempted where vomiting and emaciation are the results of a ptosis with a bend of the pylorus (stenosis) in connection with a pronounced neurosis — the result may cause disappointment.

It is therefore natural that the operation should be undertaken only on strong indications. The great majority of my cases have shown good results — so good that some of them can be compared with the results of resections in cases of *strictura pylori*.

Apart from a firm and lasting fixation, the stomach should take a natural position without any bending or other unnatural hindrances to the movability. The bending which is often brought forth by the fixed pylorus when the *prae-pyloric* part of the stomach is loosely hanging down in the belly, should be raised, and this is done by drawing the *curvatura minor* upwards and the pylorus to the *right*.

As I reported in my demonstration in the Surgical Society

in Oslo several years ago, the pancreas can well be used for the closing of the duodenal end in cases where the ulcer is situated so distally that the duodenum has to be cut without forceps so far down that an invagination is impossible. As I mentioned then the pancreas is conveniently situated and may easily be

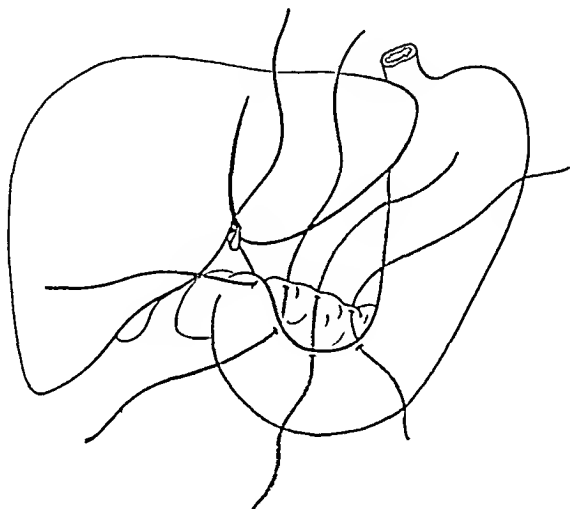


Fig. 1.

stitched over the duodenal end with deep sutures — which will give no symptoms afterwards. But why not then make use of the firmly fixed upper brim of the pancreas for raising and fixation of the stomach?

Technics of Operation.

The operation is fairly simple. Thin silk should be used and a round, thin and well curved needle. The operator places 3 deep sutures in the upper brim of the pancreas — avoiding the sometimes easily visible vessel and letting the silk firmly penetrate the *curvatura minor* where this is at its lowest. When the thread is tightened and tied the stomach will be hoisted like a sail and fixed in a permanent position. A fourth thread should combine *lig. teres*, where this ligament leaves the liver, with *curvatura minor* some 0.6 inches oral to the pylorus. When this suture is tightened the pre-pyloric part of the stomach will be drawn to the right so that *curvatura minor* is stretched like a fishing-net. The bend of the pylorus, which is due to the pendulous and extended pre-pyloric part, is thus raised and the u-formed stomach loses this form. (Fig. 1.)

This operation which I have performed in the course of the last 18 years have always been carried through without complications except for one rather severe pancreatic hæmorrhage, which was, however, easily stopped by means of a circular suture giving no later symptoms. The suture through the upper brim of the pancreas has never proved to cause complications of any kind. Recovery as a rule follows immediately upon the operation — a fact which has made me believe that the sutures along *curvatura minor* may have a stimulating effect upon the peristalsis resulting in an elimination of the atonia. I have not found it necessary with any long after-treatment apart from usual light diet.

Later Examination of Results.

I have gathered particulars about the post-operative state of 74 of the patients whom I have treated with my gastropexia-operation during the last 18 years. Of the 74 cases 66 may be regarded as perfectly uncomplicated ptoses, whereas the last group, consisting of 8 cases must be considered as complicated ptoses more or less neurotic.

38 patients, who have now moved without leaving their new addresses, have been examined by me at the earliest 2 years after treatment. Of these 38 only one has not shown evident signs of recovery, but this patient has been suffering from pronounced neurotic symptoms, before the operation as well as afterwards.

The group consisting of 74 patients who have answered my questionnaire form can be divided into 2 groups. The first one including 66 patients who are all of them exceedingly well pleased with the results; nausea and vomiting have ceased and most of them can eat all sorts of food. The weight has increased by about 20 lbs. for the great majority, for a few of them by even more and for one patient by as much as 55 lbs. As a rule the retention is relieved and X-ray shows a good position of the stomach. Frequently a spontaneous evacuation takes place immediately after the operation.

As for the 8 neurotic patients the results have not been good. Today, afterwards, one may say that these patients had better not been operated, but the many excellent results made even these cases seem hopeful.

As I have mentioned in my introduction, the operation should be undertaken only on the strongest indications — which also



Case 3.

14 days before the operation (gastropexy).

4 months after the operation (gastropexy).

2 years after the operation (gastropexy).

is seen from my material. If the ptosis is complicated by neurotic phenomena or neurasthenia the result of the operation will naturally often cause disappointment.

13 of the patients who have answered my questions must be omitted, as they are either dead from diseases different from gastropexy or now suffering from other serious diseases.

2 patients have been operated for cholelithiasis and 3 patients for ulcer. That a simultaneously incipient abdominal ulcer may have been overlooked during the operation cannot assuredly be denied, but the patients had no symptoms and the X-ray showed no signs of ulcer by that time. These 3 cases of gastritis and reduced acidity may be said to bear out the gastric aetiology for ulcer which is asserted among others by T. KALIMA.

The 66 patients with uncomplicated gastropexy some of them as far back as 18 years ago have been operated according to my method, have given information of partly excellent results. This proves that the method must be regarded as quite satisfactory in cases where there is absolute indication.

I want to thank those of my colleagues who have supplied me with information about patients who have been operated, and also professor dr. med. OTTO LOUS MOHR who has kindly expressed as his opinion that the anatomical conditions should enhance the possibility of a lasting pexy.

I am also much obliged to professor T. KALIMA of Helsinki, who has stimulated the publication of this work.

Table.
74 Cases of Gastroptosis.

No.	Sex	Born	Duration of several years	Op.	Material followed up		
					D.	Result	Weight
1	f.	1907	Several	1943	1947	<i>Dyspepsia</i> C	17 kg.
2	"	1904	2	1946	1947	C	3 "
3	"	1907	Several	1939	1947	C	25,4 "
4	"	1902	20	1946	1947	B	
5	"	1903	Several	1938	1947	B (exc. fat.)	
6	"	1922	Several	1944	1947	B (exc. fat.)	
7	"	1877	Many	1944	1947	B	8—9 "
8	"	1900	18 years	1947	1947	B (fat.÷)	10 "
9	"	1896	?	1939	1947	(+)	10 "
10	"	1911	Several	1944	1947	B (careful)	
11	"	1906	Several	1947	1947	C	increased in w.
12	"	1925	Since child	1942	1947	C	7 kg.
13	"	1897	Several	1941	1947	C	10 "
14	"	1907	14 years	1946	1947	C	3,5 "
15	"	1913	One year	1943	1947	C	7—8 "
16	"	1913	Several	1947	1947	B (careful)	0
17	"	1918	1½ year	1938	1947	B (qualm)	
18	"	1907	15—16 years	1944	1947	C	8 "
19	"	?	3 years	1941	1947	C	8 "
20	"	1907	Several	1929	1947	C	
21	"	1894	Many years	1946	1947	C	increased in w.
22	"	1889	Several	1939	1947	C	6 kg.
23	"	1887	Several	1943	1947	C	
24	"	1902	Many	1946	1947	B (fat.÷)	11 "
25	m.	1927	Several	1946	1947	C	
26	f.	1916	Several	1944	1947	C	
27	"	1910	Several	1946	1947	C	7—8 "
28	"	1886	Many	1938	1947	B	
29	"	1891	Many	1937	—	C	
30	"	1900	Many	1944	1947	C	5 "
31	m.	1899	6	1946	—	C	
32	f.	1905	Many	1942	—	C	6 "
33	"	1908	20	1946	—	C	
34	"	1899	Many	1945	—	C	7—8 "
35	"	1898	15	1944	—	B	10 "
36	"	1900	15	1940	—	C	
37	"	1887	Several	1938	1947	C	6—6 "
38	"	1897	9	1929	1947	C	"much"
39	"	1892	Many	1941	—	C	7 kg.
40	m.	1898	Many	1936	—	C	10 "
41	f.	1896	4—5	1938	—	C	
42	"	1913	Several	1943	—	C	+
43	"	1918	Many	1936	—	C	
44	"	1885	5—6	1936	—	C	7 "
45	"	1917	2½	1938	—	C	
46	"	1901	Several	1941	—	C	+
47	"	1901	14	1937	—	B	
48	"	1898	Many	1938	—	C	9 "
49	m.	1904	20	1944	—	B	
50	f.	1924	Many	1946	—	C	3 "
51	m.	1888	Several	1942	—	C	+

Table. (Cont.)

No.	Sex	Born	Duration of several years	Op.	Material followed up		
					D.	Result	Weight
52	f.	1883	Many	1934	—	C	15 kg.
53	»	1918	Many	1947	1947	C	+
54	m.	1886	Many	1936	—	C	+
55	f.	1901	Several	1938	—	C	14 »
56	m.	1903	8	1945	—	B	
57	f.	1899	Several	1945	—	C	+
58	»	1917		1946	—	C	10 »
59	m.	1904	8—9	1940	—	C	7.6 »
60	f.	1911	Many	1938	1947	C	14 »
61	»	1880	Many	1942	—	B	
62	»	1897	Many (21)	1938	—	B	15 »
63	»	1895	20	1941	—	C	8 »
64	»	1907	Several	1943	—	B	
65	»	1910	Many	1943	—	B	
66	»	1906	Several	1945	—	C	23 »
67	»	1901	Several	1946	—	U	
68	m.	1926	Few	1946	—	U	
69	f.	1886	Many	1946	1947	U	
70	»	1898	15	1940	—	U	(neurastenia)
71	»	1923	1½	1944	—	U	(neurastenia)
72	»	1901	15	1942	—	U	(colitis)
73	»	1906	10	1945	—	U	(colitis)
74	»	1899	10	1943	—	U	(epilepsia)

C = cured

B = better

U = uncured

Summary.

The author speaks of experiences in connection with his new method of operation for gastropotosis. Of the operated patients 74 have been examined afterwards and 66 of them have shown good results.

From the County Hospital of Möre and Romsdal.
(Chief: H. FR. HARBITZ, M. D.)

Penicillin in the Treatment of Tuberculous Empyema with Mixed Infection.¹

By

H. FR. HARBITZ and ALF PALMSTRÖM.

Two years ago one of the authors (HARBITZ) referred the results of surgical treatment of 22 cases of tuberculous empyema, of which 16 were fistulous and 6 closed. The cases with closed empyema were treated with thoracoplasty. When a radical thoracoplasty was not sufficient in the fistulous cases, a radical pleurectomy, mostly as a Schede operation, was added. Two patients died after the operation, and six died later of tuberculous disease. The surviving 14 patients were all clinically cured, the fistula closed (10 cases), all were without tubercle bacilli (in sputum) and 13 were working as before the operation. They had been reexamined from 2—7 years after the last operation. This material was published in 1945. As we after the war got in possession of penicillin this remedy has been used in ten new cases of tuberculous empyema with mixed infection. The results have been so encouraging that we find it worth while to describe the cases. We would point out, however, that in some cases tubercle bacilli in the pus have not been found before the operation, but the development of the empyema and the clinical course in these few cases do not differ from similar cases where bacilli are found.

In previously published material on the subject similar conditions prevail (HEDBLÖM, SÖDERHJELM, SEMB).

Penicillin has been used both intramuscularly, generally, and locally instilled. According to the treatment the material can be divided into two groups: 1) Those cases which have been clinically cured by the use of penicillin alone or in connection with punctures, four cases in all, and 2) those cases which by the use of penicillin

¹ Paper read at the annual meeting of the Norwegian surgical society in Oslo October 31st 1947.

have been fitted for further operative treatment, thoracoplasty and pleurectomy. — Beside the penicillin we have in some cases also used solution of sulphathiazol instilled in the pleural cavity, and we have the impression that also this medicament has had a favourable effect.

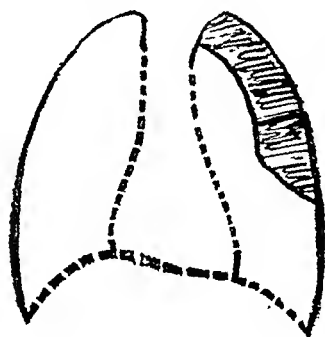


Fig. 1.

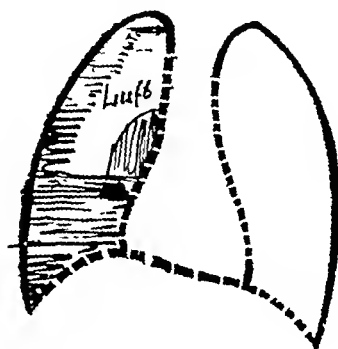


Fig. 2.

Group 1. Four cases of tuberculous empyema with mixed infection treated only with penicillin and pleural punctures and in one case rib resection with pleural drainage.

1. Paula R. 22 years of age. 8/7—28/7. 1946.

1944 pulmonary tuberculosis, tb + in sputum, treated with artificial pneumothorax followed by pleural effusion, later purulent with mixed infection and fever. Duration of the empyema two years, no clinical sign of bronchial fistula. Treated with punctures and aspirations during a long period. X-ray shows a localized exudate on the upper two thirds of the left lung (Fig. 1). — She then was treated with four *pleural punctures* every second to fourth day, and instillation of penicillin 30—50,000 units and 3 gm sulphathiazol in solution. By the first thoracocentesis 150 cc pus (tb ÷ by culture) was aspirated, later 40—50—40 cc, later the exudate did not reproduce. The cavity of the empyema again was transformed to a partial pneumothorax which was maintained for one year when it was stopped and the lung expanded.

Since discharge from the hospital July 1946 the patient has been able to do housework.

According to the origin and development of the empyema it has been recorded as tuberculous with mixed infection.

2. Ingvald G. 33 years of age. 25/4—7/6. 1946.

Rightsided pulmonary tuberculosis treated 1936 with artificial pneumothorax and cauterization, later clinically cured and without treatment for many years. 1944 again ill with pleural exudate, expectoration of large quantities, 100—300 cc, of pus every day, tb +, fever, dyspnoea, cyanosis, loss of weight.

Mixed infection in the purulent pleural exudate. X-ray showed liquidothorax on the right side with total collapse of the lung (Fig. 2).

In April 1946 penicillin — 100,000 units daily — was injected intramuscularly for 11 days in addition to frequent *pleural punctures* with instillation of penicillin 50,000 units. The first time was extracted 300 cc pus, later 200—200—200—40—30—0—70—30—10 cc. No fever since the second day after first puncture, no expectoration since the twentieth day. Discharged in good condition after six weeks. Sedimenta-

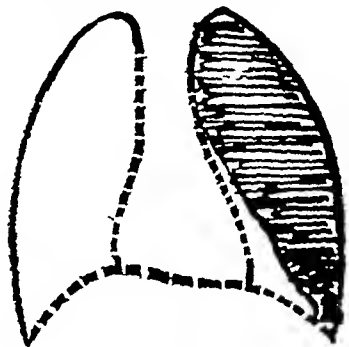


Fig. 3.

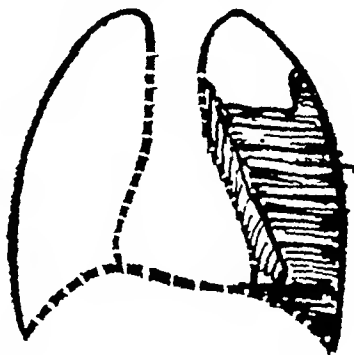


Fig. 4.

tion rate sank from 117 mm to 20 mm. Hgb. 100 %, gain in weight $7\frac{1}{2}$ kilo. X-ray shows that the lung begins to expand, the exudate does not reproduce. Later clinically cured without expectoration and he has been doing his ordinary work as a butcher since concluded treatment 2 years ago. X-ray pictures show that the lung soon expanded to the thickened pleural wall.

3. *Hjördis M.* 23 years of age, 17/8. 1945—6/2. 1946.

Originally she had a leftside closed sterile tuberculous empyema as the result of an artificial pneumothorax and cauterization. X-ray picture shows a total empyema (Fig. 3). In the autumn 1945 a *total thoracoplasty* in two stages was performed. After the last operation she got fever, heavy expectoration particularly by changing position, indicating a bronchial fistula, retention and mixed infection. By puncture pus was extracted. Tb ÷ in sputum and in the pleural exudate. As the temperature was rising and the quantity of expectoration increasing a *rib resection* with pleural drainage in the lower interior part of the left thoracic wall was performed in November 1945. The drainage seemed to be good, but the temperature would not fall. Then from January 1st 1946 she received penicillin — 100,000 units daily for ten days. Following this treatment the temperature quickly fell to normal, the secretion ceased, the drain was removed and the fistula was dry when she was discharged February 2. 1946, one month after the treatment was started. X-ray does not reveal any visible pleural cavity. She has since been well without fistula and working more than $2\frac{1}{2}$ years. Tb ÷ in culture from a sparse sputum three times.

4. *Berit G.* 44 years of age. 5/4—4/6. 1946.

Since November 1942 leftside pulmonary tuberculosis with tb + in sputum and empyema following artificial pneumothorax and cauterization

1943. Numerous tubercles were seen on the surface of the lung. Later spontaneous perforation of pus through a fistula in the thoracic wall below the left breast with periods of fever. X-ray picture on admission in April 1946 showed a pneumo-liquido-thorax with the lung collapsed medially on the left side (Fig. 4). She was treated with penicillin intramuscularly 100,000 units daily for nine days, and at the same time *pleural punctures* with instillations of penicillin 20—30,000 units daily for 8 days, later on every 5—6 days, six times in all. Every time the air in the cavity was aspirated to negative pressure 20—30 mm water. The fistula closed, she was without fever and expectoration. She was discharged after three months and was working one month later. X-ray pictures showed that the lung expanded slowly and in November 1947 the expansion was complete. She has later been well and working now more than two years.

In these four cases no thoracoplastic operation has been necessary but pleural punctures and in one case rib resection and pleural drainage have been performed. In one case (3) general intramuscular treatment with penicillin has been sufficient to sterilize the empyema thus obtaining conditions for further spontaneous healing.

Group 2. Six cases of tuberculous empyema with mixed infection which by the use of penicillin are made fitted for further operative treatment.

5. *Ragna S.* 42 years of age. July—Dec. 1946.

Bilateral pulmonary tuberculosis since Dec. 1945, two cavities in the right apex. The left side pulmonary tuberculosis was treated with artificial pneumothorax and cautery. Following a spontaneous rupture of a cavity in left lung a pyopneumothorax with fever developed. Tb + in sputum, tuberculosis in the larynx. Asthma for three years. 1000 cc pus had been aspirated from the pleural cavity a few times. Tb+ in the pleural pus. The general condition was very bad, the patient was very thin, hoarse, dyspnoeic. X-ray picture showed a total liquido-pneumothorax on the left side and a cavernous process in the right apex (Fig. 5). She was then daily treated with penicillin generally and *pleural punctures* with instillation of penicillin 30,000 units and solution of sulphathiazol 2 gm, four times in all. Following this treatment the patient improved, the purulent pleural effusion was thinner, and we were from 5/9 to 2/11. 1946 able to perform a total leftside *thoracoplasty* in three stages. — The empyema then healed quickly and has later been clinically cured now for two years. The sedimentation rate was normal and she gained 6 kilos in weight.

The tuberculosis in the left apex with the cavities was however still present, and she had tb + in a sparse expectoration. Novbr. 1947 first stage of a small thoracoplasty was performed with removal of the two

upper ribs and apicolysis. The second stage with removal of the 3rd and 4th rib was performed in Jan. 1948. These operations she stood well and was clinically cured also for the rightside pulmonary affection. Only occasionally small quantities of expectoration, tb \div twice by culture. She is still to be considered a convalescent.

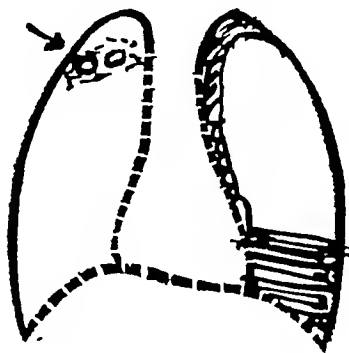


Fig. 5.

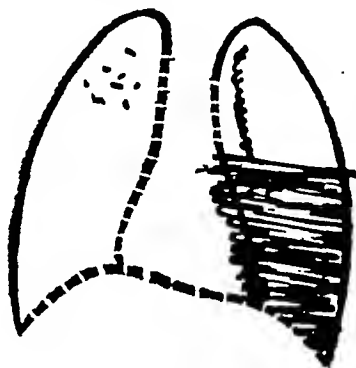


Fig. 6.

6. *Margit A.* 32 years of age. 1/4—25/9 1946.

Pulmonary tuberculosis, mostly leftside, since 1913.

Treated with artificial pneumothorax and cautery with subsequent pleural effusion, later on purulent accompanied by fever. X-ray picture showed total liquido-pneumothorax on the left side and small pathological findings also in the right lung (Fig. 6). She was thin with high fever, much expectoration, clinical signs of bronchial fistula. Tb + in sputum and in the purulent pleural exudate.

Rib resection with drainage was performed anteriorly and slightly laterally on the left chest wall. The drainage seemed to be very good, but her condition did not improve and she had high fever. The drain-tube was then removed and the fistula closed with a vaselin compress. The pleural cavity was punctured and penicillin — 50,000 units — injected every 4—5 day. After 1½ month coloured fluid injected in the pleural cavity showed no sign of bronchial fistula, and the external fistula in the thoracic wall closed in two months. The exudate decreased in quantity and was thin. Then sulphathiazol, 2 gm in solution, was injected every second day for a period. The general condition improved and she gained in weight, though there was still tb + in sputum. After treatment her condition had improved so much that from July—Sept. 1946 we could perform a total *thoracoplasty* on the left side — 1.—10. rib posteriorly and 2.—3. rib anteriorly. After a treatment of 5 months in all, she was discharged clinically cured. She has later been well without expectoration, tb \div , and working now for two years.

7. *Lars M.* 24 years of age. 6/7—28/8. 46 and 4/10—26/11. 46.

Leftside pulmonary tuberculosis since 1945, treated with artificial pneumothorax, thoracoscopy, but no cautery. A subsequent pleural effusion was tapped. In May 1946 ill with fever and much expectoration, loss of weight 17 kilos during six weeks. On admission July 1946 he was

in bad condition, high fever, septic appearance, large quantities of expectoration, clinical signs of bronchial fistula. X-ray revealed a left-side total liquido-pneumothorax and dispersed dotted areas on the whole right lung (Fig. 7). Tb + in sputum and in the purulent pleural effusion.

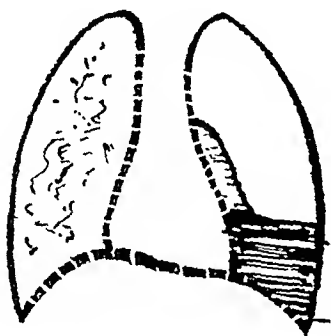


Fig. 7.

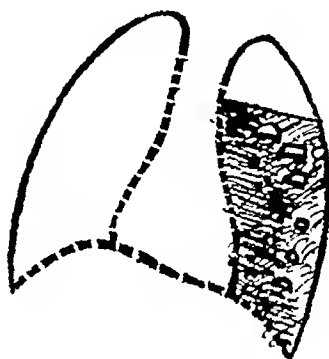


Fig. 8.

The patient was treated with frequent *pleural punctures* with instillation of penicillin 20—50,000 units and solution of sulphathiazol. After five days he was without fever. The puncture with instillation of penicillin was however continued for seven weeks when he was transferred to the sanatorium for observation of the rightside process. Also here he was treated with pleural punctures and instillation of penicillin. Pleural fluid then came up in the mouth, so the bronchial fistula persisted and he had tb + in the expectoration. A sinus then perforated in the left axilla.

In October 1946 he was much improved, without fever, the rightside pulmonary process had practically disappeared but the effusion in the pleural cavity did not subside. In October 1946 a total leftside *thoracoplasty* with apicolysis was performed. An abscess again emptied in the axilla, but the fistula closed.

He has later been well without cough or expectoration, no fever, no fistula, sedimentation rate 5 mm/1 hour. X-ray shows the totally collapsed chest-wall on the left side and the tuberculous process in the right lung seems to be cured. He is working.

8. *Kristian H.* 46 years of age. 8/4—18/5. 46 and 3/7—25/8. 46.

Rightside pulmonary tuberculosis for four years, artificial pneumothorax, cauterization. Subsequent empyema with mixed infection over the right apex; treated with punctures and suction-drainage posteriorly. Tb + in sputum and in the fistulous pus. The fistula later closed but he then coughed up large quantities of pus from the empyema — probably through a bronchial fistula. New fistulas opened in the infra-clavicular fossa and these fistulas led up to a rest cavity of the empyema inside the axilla. The course of the fistula and cavity was stated by X-ray and contrast filling.

The fistula was treated with injections of penicillin for 8 days, 20—

30,000 units daily, and the secretion subsequently ceased. Tb ÷ in pus from the fistula and in sputum. Meanwhile the fistula did not close, and after some days of local treatment with penicillin a partial *thoracoplasty* anteriorly below the right clavicle was performed, and a flap of the pectoral muscle was laid in. Then penicillin intramuscularly for one week. There was very little reaction on this major operation, the wound healed quickly and the fistula closed after four weeks. He was then discharged from this and the other hospitals where he had lived for four years. He has later been well without cough or expectoration and working as a farmer more than two years.

9. *Martin V.* 28 years of age. 1/12. 45—5/9. 46 and 29/11. 46—5/1. 47 and 15/8—28/8. 47.

Bilateral, mostly leftside pulmonary tuberculosis since February 1945. Tb + in sputum. Treated with leftside artificial pneumothorax, later cautery with subsequent pleural effusion and development of an empyema with mixed infection (pneumococci) (Fig. 8).

In Dec. 1945 he was treated with *pleural punctures* and instillation of penicillin 10,000 units four times in all. In spite of this treatment a fistula penetrated anteriorly through the chestwall and he got a septic temperature. On Dec. 17th 1945 a *rib resection* and pleural drainage was performed. Neither could this operation stop the infection, and the high temperature continued. March 1946 penicillin generally 100,000 units daily, was given without marked result. The drain was then removed. Pleural puncture with instillation of penicillin every second day and of solution of sulphathiazol 2 gms every second day was performed. Following this treatment the temperature sank quickly and he improved so much that we could start a total *thoracoplasty* three weeks later, in three stages with removal of 1.—6. rib anteriorly and 1.—10. rib posteriorly. This was in the period April—August 1946.

He then improved considerably, the secretion from the fistula diminished and he was discharged in September 1946. The following year he was quite well but the secretion increased, the closed fistula opened again and he had to be treated twice with drainage for a short time and penicillin locally and once only penicillin generally and locally, the last time in August 1947 when he also received X-ray treatment on the fistula. Since the fistula has been closed but occasionally when he catches a cold the fistula may open and give a little secretion which disappears in a few days when he himself injects penicillin intramuscularly two or three times. He then is well for three to four months. He is without expectoration, tb ÷ in many cultures from sputum, he has gained in weight and has been working as a farmer more than two years since the last treatment.

It is still too early to decide if the fistula will remain closed, and the importance of the use of penicillin can be discussed, but I would say that apart from the necessary draining procedure it was the penicillin which defeated the secondary infection with

the septic clinical picture, and made the patient in a condition to undergo the operations.

10. *Edvin V.* 26 years of age. 13/10. 45—5/2. 46.

Leftside pulmonary tuberculosis since 1943 treated during the war in Scotland with artificial pneumothorax, later in 1944 with total thoracoplasty. Subsequently a pleural empyema developed on the operated side and perforated through a fistula in the axilla. General condition was bad, loss of weight 23 kilos. X-ray on admission (Fig. 9).

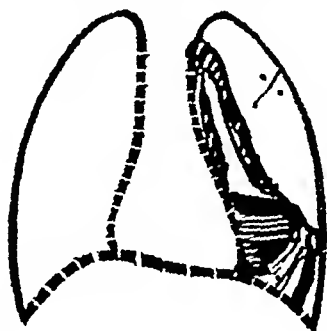


Fig. 9.

A drain put into the fistula gave no result. On October 17th 1945 a *rib resection* with pleural drainage was performed with favourable results for a short time. Then again retention with fever. From Nov. 1945 pleural punctures with instillation of penicillin 100,000 units daily, was given, later a drain was laid in. Penicillin administered generally for two days after which a thoracoplasty was performed as a radical *pleurectomy* with excision of the chest wall and parietal pleura in the area around the sinus. The pleural cavity, which was 20 cm long, was irrigated and sulphathiazol in substance (powder) was applied. A small drain was inserted. Penicillin generally for one week. The wound healed quickly, he was up and out of bed on the ninth day after the operation, discharged the 17th day with the wound healed and without any fistula.

Later well, no fistula, no expectoration, tb ÷, and he has been working on a freezing plant since the operation two years ago.

To sum up we can say the following:

Of the 10 described cases of tuberculous empyema with mixed infection, only two have been closed interiorly and exteriorly. Five cases have had symptoms of a bronchial fistula (probably more cases), and in seven cases an external fistula has existed.

Four cases were treated only with penicillin either locally or generally or both together with punctures and in one case rib resection and pleural drainage. They are all clinically cured for their tuberculous empyema, tb ÷, and all are working since conclusion of treatment about two years ago.

In the other six cases — of which five had an external fistula and two at the same time bronchial fistula — penicillin was used as local intrapleural instillations and in some cases also generally. Draining operations have also been performed. In this manner they were all so improved that a radical thoracoplasty or pleurectomy could be performed in one or more stages.

Five of these cases are clinically cured with closure of bronchial and external fistulas. In the sixth case the external fistula opens occasionally but closes promptly after the administration of penicillin.

Most of the ten patients are without expectoration, and they are all without tubercle bacilli. One patient was later treated with an apical thoracoplasty on the other lung with satisfactory result.

Of the ten patients eight are working ordinarily, one is doing light work and one is convalescent after the operation on the other lung, while the empyema has been cured. In nine cases treatment was concluded two years ago, in the tenth case one year ago.

When we compare this result of treatment with that of the former material we have the impression that penicillin is of great importance in the treatment of tuberculous empyema with mixed infection.

Summary.

10 cases are described, of these 5 had bronchial fistula and 7 had external fistula. Penicillin generally or locally instilled or both have been used in connection with pleural puncture in three cases and rib resection and drainage in one case. All these four cases are clinically cured without other procedure. They are without tubercle bacilli, and are working now two years after treatment.

In the other six cases penicillin has been of importance to make the patients fitted for operation. Thoracoplasty and in some cases pleurectomy have been performed. The patients are all clinically cured, the fistula closed in all but one case where the fistula sometimes opens. In this case the patient himself injects penicillin, and the fistula closes in a few days. All the patients are without tubercle bacilli, and all but one, who was recently operated for a cavernous affection on the other lung (successfully) have been working since conclusion of treatment two years ago.

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(Chief: Professor H. OLIVECRONA.)

Studies on Circulation (ECG, Oxygen Saturation) During Anaesthesia and Operations for Angina Pectoris and Hypertension.

By

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Stockholm.

The initial purpose of the present investigation was to find out whether cervico-thoracic sympathectomies in man cause any immediate changes in the electrocardiogram. The investigations were subsequently extended to include the different stages in the anaesthesia, in cases of angina pectoris and hypertension. Repeated electrocardiograms were taken before the operations, as well as during and after. The oxygen saturation of the arterial blood was followed.

Earlier authors, who have recorded electrocardiograms during operation have, contrary to us, dealt with a comparatively normal material as regards the circulatory system.

In order to study the effect of anaesthesia and the variations in oxygen saturation, these two factors have been varied *experimentally* for a limited period of time, as a rule directly before the surgical intervention.

In the present paper, ECG-observations during the following "stages" will be discussed, viz. "Mental strain", "Morphine-scopolamine", "Oxyphylline", "Barbiturate intravenously", "Inhalation anaesthesia", "Intubation", "The operative procedure before sympathectomy", "Sympathectomy", "Closing of the wound", "Oxygen administration and waking up", and "After waking up". Observations regarding oxygen saturation and blood pressure will be dealt with separately (pp. 73 and 75).

Material.

The investigations were carried out on patients admitted to the Neurosurgical Clinic of Serafimerlasarettet for operation owing to hypertension and angina pectoris. During the past six to seven years, 350 cases of hypertension were operated upon according to PEET or SMITHWICK, usually with removal of the lower four to five thoracic ganglia and the upper one or two lumbar ganglia as well as the corresponding part of the splanchnic nerve. 80 cases of angina pectoris were operated upon, with sympathectomy including the stellate ganglion and second to fifth thoracic ganglia. Most of the bilateral operations were performed in two stages, except for the operations acc. to PEET.

Among these patients, 38 cases of angina pectoris and 16 hypertensives were submitted to a close examination, as described above.

Many patients had angina pectoris as well as hypertension. A great number of the patients with angina pectoris were invalidated by their disease, some of them unable to walk even slowly for more than twenty metres. Many of them had a history of several myoeardial infarctions or attacks of pulmonary edema. Only a few had normal electrocardiograms at rest. In some cases there were signs of decompensation even at rest.

The patients were subjected to careful cardiological examination before as well as after the operation. Information regarding these studies is given in papers by S. HAMMARSTRÖM (1947) and I. LINDGREN & H. OLIVECRONA (1947). Immediate complications and operative mortality have been reported by S. LINDGREN (1947).

Technique.

Barbiturate was given the evening before the operation. As premedication, generally 0.01 Gm of morphine and 0.0004 Gm of scopolamine were administered subcutaneously one hour before the anaesthesia was started. The dose varied according to age and sex. In some cases intravenous injections of these drugs were given experimentally. Lately patients suffering from angina pectoris have been given barbiturate also two hours before the operation.

The anaesthesia was induced with a barbiturate — *narcotal* (syn.: *eunarcon*) — given intravenously. Then, general anaesthesia was usually applied with ether as the principal anaesthetic. In addition, a gas mixture, oxygen plus nitrous oxide in proportions of 1 : 1 to 1 : 3 was given, with the higher oxygen content particularly in the angina pectoris cases. The patients were all intubated. We used a semi-open or a closed circuit with a soda lime container for absorption of the carbon dioxide. The gases were administered in excess. The anaesthetics were given by a trained anaesthetist.

The operations upon the angina pectoris patients lasted from 1 to 1½ hours. Towards the end of the operation, the patient was roused by means of pure oxygen.

All electrocardiograms were taken in the recumbent position. The cases of hypertension, which were operated upon in a lateral position, were examined only before or after the actual surgical intervention.

Generally the three standard limb leads and Lead IV R¹ were registered synchronously. As a rule, previous investigators have registered each lead separately. The synchronization offers, *inter alia*, increased certainty when interpreting the curves, especially with regard to the ST—T segment.

It proved a great asset to have at our disposal in each case a whole series of ECG:s that could be compared with each other.

Instead of a dubious interpretation of the electrocardiograms, we sometimes preferred a mere description of the curves.

A statistical analysis of the generally very complex conditions did not seem suitable. Instead we concentrated on the study and analysis of the individual cases. The presentation is intended to give, *inter alia*, a general picture of what *may* happen under the circumstances involved. As a rule, negative observations will not be mentioned.

Results.

Effect of Different Factors on the Electrocardiogram.

I. "Mental strain".

When studying electrocardiograms in connection with an operation, the possibility of changes due to nervousness and agitation should be considered.

MAINZER and KRAUSE (1939) noted increased amplitudes of P and T in connection with fear, as well as a decrease of the QRS-complex with a depression of the ST—T region. SPRINGER (1935), and LJUNG (1947) also have studied fear reactions.

In spite of premedication, a number of our anginal cases had their attacks with ECG changes also immediately before operation. Because of the high frequency of their usual attacks, we could not interpret the possible preoperative ECG changes as necessarily due to fear of the impending operation.

II. "Morphine-scopolamine".

These two drugs are considered to have, to some extent, opposite effects on the autonomic nervous system.

As a rule, they have been examined separately by earlier authors (cp. LEPESCHKIN). VON HUEBER (1940) found, in dogs, a temporary negativization of the T wave in Lead II (and III) after intravenous injections of morphine, and DREW (1946) observed in man only an increase in pulse rate.

¹ According to the nomenclature of the so called Standardization Committee.

Scopolamine (and atropine) have been stated to produce varying electrocardiographic changes, the rate of injection and the dosage being of considerable significance. Changes have been noted, *inter alia*, in the P and T waves. One author (quot. LEPESCHKIN) mentions a depressed ST segment (in a case of angina pectoris). Nodal rhythm after the subcutaneous injection of atropine was observed by ÖHNELL (1944).

KURTZ *et al.* (1936) used morphine-scopolamine preoperatively (subcutaneously one hour before operation). They usually found an increase in the pulse rate and, in addition, in the majority of the cases a slight depression of the ST-segment and elevation of the T wave.

As a matter of routine, we gave morphine-scopolamine subcutaneously one hour before operation.

In seven instances the injection was given *intravenously*. In these cases ECG was recorded before as well as immediately after the injection.

Results:

In three of these latter cases there was an increased pulse rate (of more than ten beats per min.). In one a nodal rhythm occurred (Fig. 1). In another case, after *morphine* injection, a slightly atypical P wave changed into a distinctly ectopic P. After an addition of scopolamine intravenously in this case, all the P waves became normal, at least temporarily. In some cases ST depression occurred, possibly the result of an increased frequency. A number of changes in the ECG may be a physiological consequence of the changes in pulse rate (cp. BENGTSSON (1948), SjöSTRAND (1948)).

One case revealed distinct changes in the ST—T region one hour after the *subcutaneous* administration of morphine-scopolamine. The ECG was normalized after oxyphylline. This might, possibly, have been a painless attack of coronary insufficiency.

III. "Oxyphylline" (Theophylline diethanolamine).

The purine derivatives usually cause no marked changes in the ECG. However, normalizations of abnormal ECG:s, especially with regard to the ST—T region, are described by several authors (FISHER *et al.* (1937), LEVY *et al.* (1940) etc.).

In eleven of our cases, where the ECG was studied during and after the intravenous injection of oxyphylline, changes were noted in four. In two, the electric axis turned to the left. In one, T was elevated (in Lead I). This was, possibly, a case of a coronary attack that subsided after oxyphylline (cp. above under the heading "Morphine-scopolamine"). In the fourth case a depression (!) of the ST segment set in.

IV. "Barbiturate intravenously".

The effect of barbiturate in the ECG has been studied on man as well as in different animals but no definite changes were found, STORM (1935), VOLPITTO *et al.* (1938).

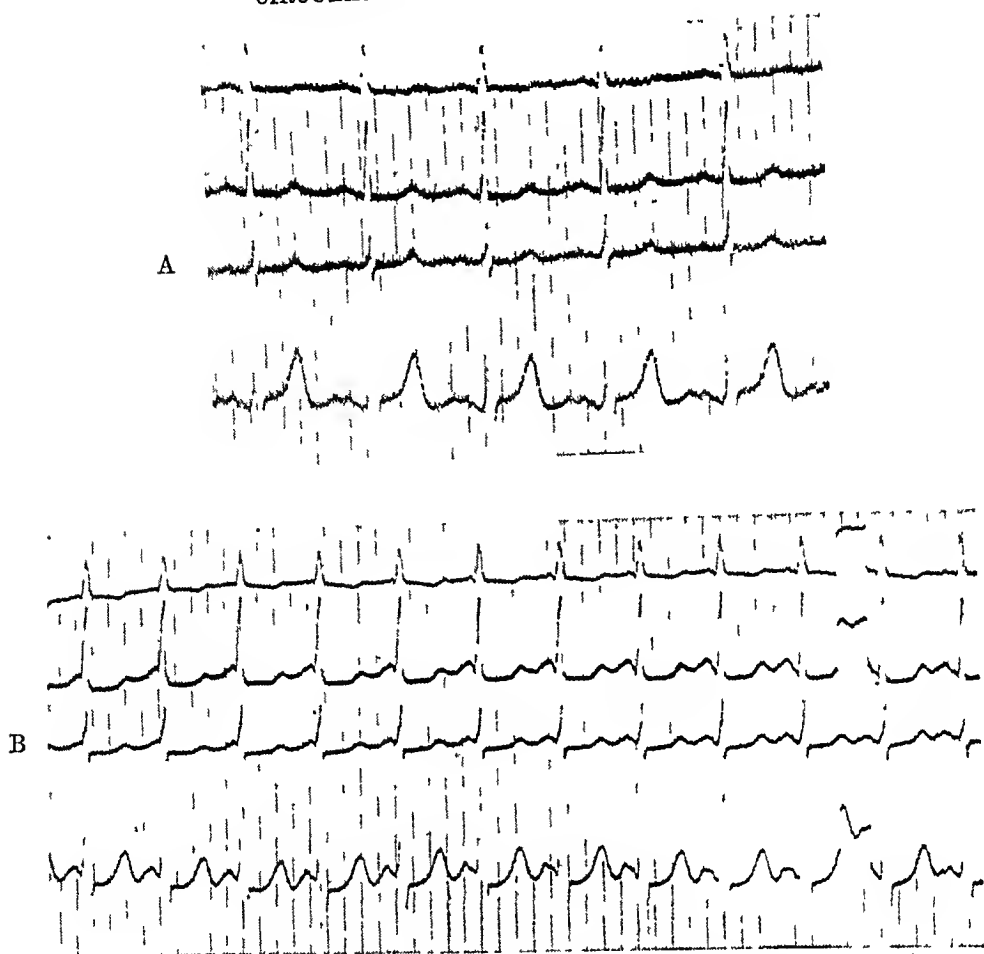


Fig. 1. Effect of morphine-scopolamine. Leads I—IV.

- A) Preoperative ECG at rest (with the hypodermic needle inserted in the vein).
 B) Immediately after intravenous injection of mor-scop.
 Increased pulse rate from 75 to 130 and displaced pacemaker. ST—T depression.

Our routine procedure was to start the anaesthesia by intravenous administration of *narcotal* (syn.: *eunarcon*). This gives, as a rule, a temporary decrease in the blood pressure.

Among twelve examined cases, nine showed electrocardiographic changes after narcotal administration. Eight of them revealed an increased frequency, and two of these had a simultaneous depression of the ST segment in the apical lead. A depression of the T wave was seen in this lead (after a coughing attack). In three other instances with increased pulse frequency, a greater amplitude of T in Lead I was observed. Two disclosed a relative deviation to the right of the electric axis.

V. "Inhalation anaesthesia".

The effect of various anaesthetic drugs on the ECG of man and animal has been examined by a number of investigators.

The liability of *chloroform* to produce, *inter alia*, cardiac arrhythmias is well known. In the past few years, electrocardiographic changes — principally arrhythmias — have been observed during *cyclopropane* anaesthesia.

Since cyclopropane is slightly superior to ether in other respects, attempts have been made to prevent these arrhythmias. ROBBINS and BAXTER (1937, 1939) sought the reason for them in the premedication. ALLEN *et al.* (1945), however, pointed out the differences prevailing between ROBBINS' *et al.* experiments (on animals) and clinical conditions. SMITH and WILSON (1944) attribute arrhythmias to the acute onset of some irritating factor, possibly supported by an increased vagus tone. MEEK *et al.* (1937, 1940), on the other hand, observed arrhythmias in cyclopropane and chloroform anaesthesia when small quantities of sympathomimetic stimulants were used. Ischemia of the myocardium, and also increased blood pressure, will intensify the irritability of the cardiac muscle (FAUTEUX, 1947).

On the other hand, *ether* anaesthesia seems to have a tendency to counteract the occurrence of arrhythmias.

KURTZ *et al.* (1936) found extra systoles only rarely during ether anaesthesia in man. Often, for the purpose of "stabilization", ether is added to the cyclopropane anaesthesia. DE TAKATS (1946) entirely switched over to ether at operations on hypertensives on account of the tendency to arrhythmia during cyclopropane anaesthesia.

The dominating arrhythmia in ether as well as *nitrous oxide* anaesthesia is, apparently, caused by a so-called displaced pacemaker, which according to KURTZ *et al.* appears irrespective of the depth of the anaesthesia. Further, these authors found minor variations in the P—Q interval and T waves during the anaesthesia, whichever anaesthetic agent employed. ST changes were observed principally in ether and cyclopropane anaesthesia. KURTZ *et al.* in their investigations never discussed the possibility that some of these ST—T changes might be due to hypoxemia. Among Scandinavian authors, FOGED and GEILL (1938) and BRECHLING and HANSEN (1939) recorded ECG before and immediately after operation under ether anaesthesia, mainly on patients with normal hearts. Only slight ECG changes were observed, *e. g.* depression of the T waves.

In the present investigations, we tried to distinguish between the ECG-changes during different stages of the anaesthesia. Regard was also paid to whether intubation had been performed previously or not. In some instances we followed the degree of oxygen saturation. The results are reported in seven different groups, four of which (A1—A4) comprise light anaesthesia, the others (B1—B3) deep anaesthesia.

As regards the different planes of the third stage in anaesthesia, we used GUEDEL's (1937) nomenclature. In the usual manner, we abbreviated the different classifications, viz., III: 1 means the first plane of the third stage, and so on.

Results:

A. "Light anaesthesia". Stage III: 1—2.

1) Light anaesthesia before the intubation. Twenty-four cases.

The pulse rate was mostly reduced when the immediate narcotal effect had vanished. A coughing jerk caused the opposite effect in one or two cases. In four cases a displaced pacemaker was observed, i. e. three cases of nodal rhythm and one with merely an "ectopic" P wave.

In seven cases an ST—T depression was noted. Only one of these cases had an increased frequency, and in two cases the ST changes might have been due to a coughing attack with hypoxemia. In two cases a normalization of ST occurred simultaneously with a decrease in the frequency. In seven cases the T waves showed a relative elevation (Fig. 2 C).

Relative axis deviation occurred, to the left, as well as to the right.

2) Light anaesthesia for a comparatively short time — maximum 10 minutes — after the intubation. Fourteen cases.

Sometimes an influence could be traced here from the preceding intubation, as for instance increased pulse rate. In most cases, however, this effect had vanished when the ECG was recorded.

Extra systoles were seen in one case.

Displaced pacemaker had occurred already before intubation in six of these cases, remaining during this stage in three of them.

A depressed ST segment was noted in five cases, four of which also had lowered T waves. In another two patients, the T waves were depressed. A normalization of T occurred in but one instance.

3) Light anaesthesia for a fairly long time — minimum 10 minutes — after the intubation. Fourteen cases.

In this group no definite tendency was noted. Normalizations as well as depressions of the ST—T region were observed.

The tendency of this portion of the ECG to be labile is evident: the ST—T region varied in both directions, sometimes in the course of a few minutes and without any apparent causes.

One patient showed a bundle branch block in connection with a fall in blood pressure (Fig. 3).

4) Light anaesthesia just before the operation but after application of local anaesthesia. Ten cases.

A subcutaneous injection of a maximum of 20 cc of a one per cent solution of procaine containing about 2 drops of epinephrine (1 : 1,000) was given to the patients with angina pectoris. ECG:s recorded within

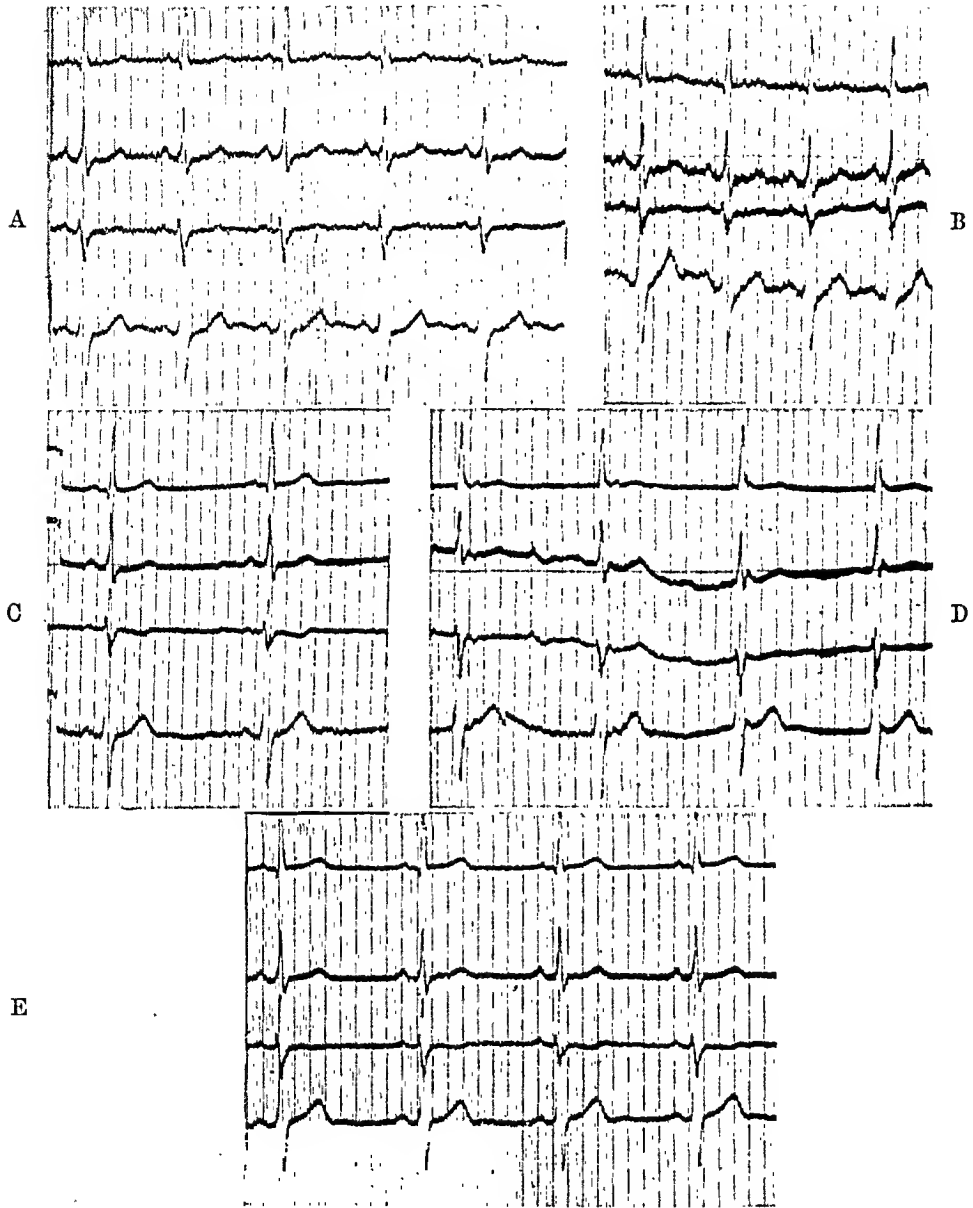


Fig. 2. A case disclosing some typical ECG changes in different stages of anaesthesia:

- A) Preoperative ECG at rest.
- B) Induction with narcotol. Slight increase in frequency.
- C) "Light anaesthesia", Stage III: 2. Lowered pulse frequency (55/min.) and more marked T waves in Lead I.
- D) "Deep anaesthesia", Stage III: 3. Nodal rhythm and lowered T waves.
- E) Returning the anaesthesia to Stage III: 2. Similar T waves as in C. Frequency as in D.

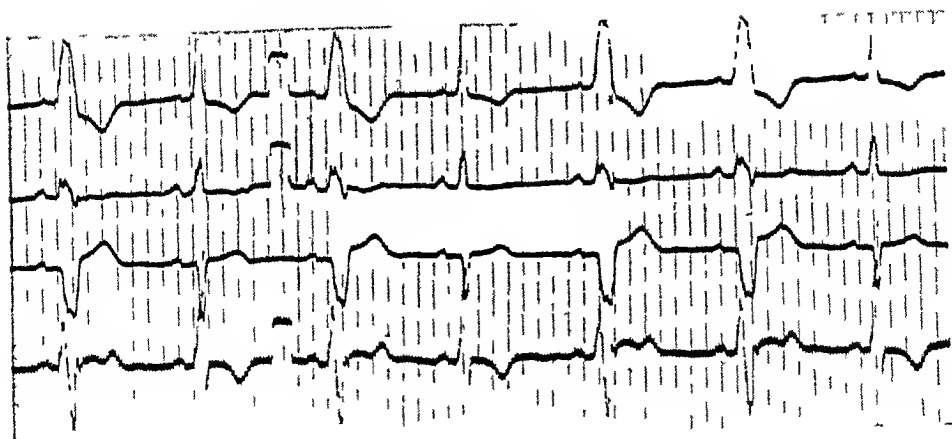


Fig. 3. Temporary bundle branch block appearing in connection with fall in the systolic blood pressure (from 160 to 100 mm Hg).

10 minutes after this injection were referred to a special group (cp. also MEEK *et al.* above).

As could be expected, however, there was no effect on the ECG of these small drug quantities.

A summing up of the ECG changes during light anaesthesia:

A displaced pacemaker is sometimes found. As regards the ST—T region, it may fluctuate without a definite tendency. A brief hypoxia or increase in the pulse rate may cause a depression. A fact of some interest is the frequent normalization of the T wave during light anaesthesia (before intubation), as compared to preoperative conditions. A lowered frequency may sometimes play a rôle here.

B. Deep anaesthesia (Stage III: 3—4, acc. GUEDEL).

1) Deep anaesthesia before the intubation. Fourteen cases. The next preceding ECG was recorded during light anaesthesia, as was also the case in the following sections, B2 and B3.

Auricular extrasystoles occurred in only one case. In seven patients a displaced pacemaker was observed (Fig. 2 D). In only two of these cases this was noticed during light anaesthesia. In one of these the pacemaker wandered further in the ventricular direction during the lowering to deep anaesthesia (Fig. 4).

In five cases the T waves and/or the ST—T region were depressed. In three of these the depression had occurred also during the light anaesthesia. A normalization of T in Lead I was noted in one case.

The electric axis turned to the right in three cases and to the left in one case.

Transient bundle branch block was noted in one case.

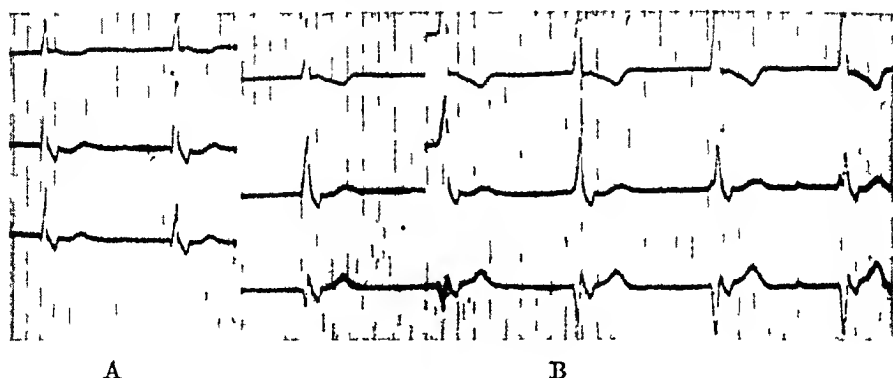


Fig. 4. The same case as in Fig. 1. Wandering pacemaker during anaesthesia. Fairly rapid deepening of the anaesthesia from stage III: 2 to III: 3 with simultaneous fall in the systolic blood pressure from 175 to 115 mm Hg.

A) Nodal rhythm.

B) 8 heart-beats after A). The pacemaker is displaced towards the ventricles. QRS becomes wider, and T in Lead I deeper. Gradual turning to the left of the el. axis.

2) Deep anaesthesia after intubation. Twelve cases.

In five cases a displaced pacemaker was observed, in two of which this had been noticed previously during light anaesthesia. In three of the cases the pacemaker was normalized when the anaesthesia then was diminished. An increase and a decrease of the P—Q interval occurred each once.

In six cases ST—T and T were depressed, as compared to "light anaesthesia".

In two cases the electric axis turned to the right.

3) Deep anaesthesia after operation.

In a few cases we had the opportunity to observe the effect of deep anaesthesia after operation.

One angina pectoris patient showed a fall in the systolic blood pressure from 140 mm Hg to 70. The oxygen saturation of the arterial blood (determined acc. JONXIS, 1943) changed only slightly, from 95 to 92 per cent. A slight ST—T depression and a pacemaker displacement occurred, not observed during light anaesthesia a few minutes earlier (Fig. 5). When we diminished the anaesthesia, with a still reduced oxygen supply, the blood pressure again rose to 140 mm. At this point the sinus rhythm returned, but the ST—T changes remained. The oxygen saturation of arterial blood had dropped to 82. After oxygen administration (blood oxygen now 96 per cent) the T waves became completely normalized.

In another case of angina pectoris, a P—Q time of 0.32 seconds was observed — preoperatively P—Q was 0.16 to 0.20 — as well as a depression of the ST—T region. The P—Q time remained abnormal even during administration of pure oxygen with a decrease of the anaesthesia. On the day after operation, the P—Q time was again normal.

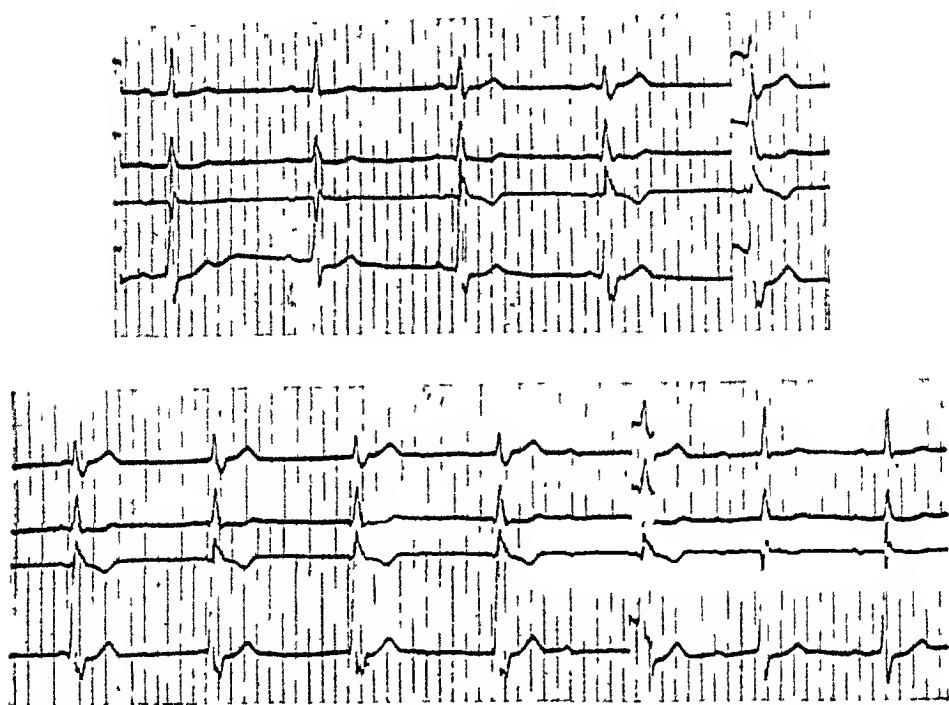


Fig. 5. Changed pacemaker during deep anaesthesia, Stage III: 3—4. Simultaneous fall in blood pressure but change in oxygen saturation. Lower curve is a continuation of the upper one.

Also a few hypertension cases belong to this group. One case had previously auricular extrasystoles which were now replaced by fairly numerous ventricular ones. These disappeared later, when the anaesthesia was diminished, but returned during a subsequent hypoxia. In some cases S—T depression as well as right axis deviation were observed, simultaneously with a fall in blood pressure during deep anaesthesia.

A summing up of the ECG changes during deep anaesthesia:

Displaced pacemaker seems to appear more often during deep than during light anaesthesia, showing a tendency to disappear when the anaesthesia is diminished. The ST—T region, as a rule, discloses a depression that cannot be explained merely as due to hypoxemia.

VI. "Intubation".

A number of authors have examined the effect on the ECG of irritation of the respiratory tract.

SIBILIA (1939) saw, on bronchography of normal cases, only an increase in the pulse rate, but in cases with pathological ECG a previous S—T depression became accentuated.

Intubation during anaesthesia was examined by REID and BRACE (1940) in thirty-five patients. Ten of these showed positive ECG findings *e. g.*, auricular and ventricular extra systoles, bradycardia, prolonged

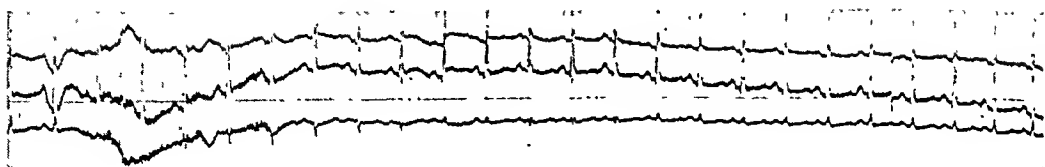


Fig. 6. ECG during intubation in relatively light anaesthesia. In the beginning we see disturbances owing to coughing jerks. The el. axis then turned to the left only to resume its previous appearance later on (see Lead III).

P—Q time and nodal rhythm. Even though these changes were connected with the intubation, it should be noted that the authors often used cyclopropane anaesthesia.

At intubation, several irritants and reflexes are involved, mostly during *light* anaesthesia. In this connection, moreover, relatively rapid changes in the blood pressure, the respiration and oxygenation of the blood should be taken into account.

In six of our own cases ECG:s were taken throughout the intubation and in another four cases when the tube was introduced into the larynx, or just after.

In order to study the effect on the ECG of reflexes elicited during intubations, these were often performed purposely under light anaesthesia with strong coughing reflexes, etc., as a consequence (Fig. 6). The tube was generally applied through the nose. In these cases the larynx was not subjected to surface anaesthesia.

Results:

In most cases a rise in the blood pressure was obtained, as expected, and in five cases an increase in the pulse frequency.

In three cases a displaced pacemaker was normalized. In another, where intubation was performed in Stage III: 3—4, a changed pacemaker remained. It disappeared somewhat later when the anaesthesia was diminished. A lowered T wave was noticed in six patients. One of these showed simultaneous normalization of S—T. Yet another patient had normalization of T.

In three cases a right axis deviation occurred.

No extrasystoles were observed.

Thus, in these cases no remarkable changes were observed in the ECG during intubation.

VII. "Operative procedure before sympathectomy".

Surgical intervention during general anaesthesia is not considered to cause any special electrocardiographic changes (cp. KURTZ *et al.* (1936) — investigations on a general surgical material). Here, of course, secondary occurrences, such as hemorrhages, have to be excluded.

We examined twenty-four cases, and ECG:s were taken repeatedly during the 20 to 30 minutes, *before* reaching the sympathetic ganglia.

In this group no particular ECG:changes were noted which could not be explained by changes in factors other than the operative procedure.

VIII. "Sympathectomy" (Cervico-thoracic ganglionectomy).

Electrocardiographic studies in connection with sympathectomy have been performed experimentally on animals. Descriptions have been offered on the effect of stimulation of the stellate ganglia, as well as on changes produced by extirpation of the ganglia. A difference in effect has seemed noticeable between left-sided and right-sided interventions. Some authors have particularly stated whether the operative procedure was directed towards the stellate ganglion or further down on the ganglionic chain. Other investigators have attacked the superior cervical ganglion.

When the stellate ganglion was experimentally stimulated on the right side the T waves were increased (ROTHBERGER and WINTERBERG, 1910), sometimes, under general anaesthesia, rapidly replaced by deeply negative T waves (Mc GUIRE, 1931). When the stellate ganglion was stimulated on the left side, the T waves were lowered (ROTHBERGER and WINTERBERG). Stimulation of the thoracic sympathetic chains at first caused a negative and then a positive effect on the T wave (JONNESCO *et al.*).

T waves and the ST segment often revealed contrasting changes.

ROTHBERGER and WINTERBERG obtained, soon after extirpation of both the stellate ganglia, a fall in the pulse rate, lowering of the P and T waves and an increased R wave. LERICHE *et al.* (1932) found on dogs, after right-sided or bilateral sympathectomy, a negativization of T in Leads II and III that remained for a few days. After left-sided sympathectomy, DAMIR and LAMPERT (1933) observed a negative T in Lead II at high take-off of the ST. These changes disappeared on right-sided sympathectomy. BURCHELL *et al.* (1939) found, after sympathectomy in animals, a high positive T wave.

The part played by the autonomic nervous system with regard to the occurrence of cardiac arrhythmias has often been discussed in connection with investigations of the effect of anaesthesia, particularly that of cyclopropane (cp. above). Thus, ROBBINS and BAXTER (1939) were still able to produce cyclopropane disturbances after vagotomy, but no P—Q changes. ALLEN *et al.* (1945) observed that cyclopropane arrhythmias in cats disappeared after bilateral vagotomy. In a few experiments they observed a nodal rhythm after bilateral vagotomy and sympathectomy.

Finally, FAUTEUX (1947) stated that coronary artery denervation in dogs prevented the occurrence of ventricular fibrillation, usually induced by myocardial ischemia and elevated blood pressure.

Only a few investigators have dealt with the immediate effect upon the human ECG of a surgical intervention on the cervico-thoracic ganglia.

After left-sided stellectomy on three patients suffering from angina pectoris, ARRILAGA (1924) obtained a slight increase of the width of the QRS complex, and in one instance a possible normalization of ST. JONNESCO and IONESCU, as well as CHAMBERLAIN (1937), found no special changes. In continuous electrocardiographic registration during

stelleectomy on some angina-pectoris cases operated upon during local anaesthesia, DONZELOT *et al.* (1940) were unable to perceive any changes in the ECG. CAHUSAC *et al.* (1943) noticed that blockade of the stellate ganglion counteracted the occurrence of extra systoles. BARNER-RASMUSSEN (1947), after such an anaesthesia, obtained a slight normalization of negative T waves and a depressed ST segment in a case of angina pectoris.

During twenty-seven ganglionectomies on our patients with angina pectoris repeated ECG:s were recorded, in eighteen during the first stage operation. In sixteen cases the operation was left-sided, in two right-sided. In the nine second stage operations, the intervention was right-sided in eight. In five cases ECG was recorded during left-sided *as well as* right-sided operations.

Results:

In eleven of the twenty-seven patients, no ECG changes were observed during the intervention. Eight of these patients were operated on the left side and three on the right; all the right-sided and one of the left-sided were second-stage operations.

Among the other sixteen cases, an earlier observed displaced pacemaker remained in seven. In three cases a displaced pacemaker was not ascertained until during the sympathectomy. In one case a changed pacemaker was normalized.

In one patient (first session, left side) a moderate number of extra systoles occurred during the sympathectomy. In one patient who got a bundle branch block during the pre-operative anaesthesia, the block remained.

In seven patients (four left-sided and three right-sided interventions) an elevation of T was noted, which in two of them appeared during the course of the sympathectomy. In one of the cases with T-wave "improvement", the peripheral pulse disappeared for a few seconds in connection with an injection of procaine into the stellate ganglion! Another case with an elevated T-wave disclosed simultaneously a lowered pulse frequency and a displaced pacemaker.

Two cases (left-sided interventions) showed lowering of the T waves.

One of the cases with a T-wave "improvement" had a simultaneous normalization of the ST segment. In two others a slight depression of the ST segment was observed.

Thus during our ganglionectomies no significant difference was noted in the ECG changes whether operation was performed on the left or on the right side. Further, we were unable to observe any difference in effect on the ECG between an intervention on the stellate ganglion alone, and an intervention comprising also the thoracic ganglia.

During the sympathectomies largely no other ECG changes

were observed than those occurring in connection with anaesthesia only. They cannot, therefore, be attributed to the sympathectomy *per se*. The fact that these studies were performed during general anaesthesia should be kept in mind.

IX. "Closing of the wound". Twenty-nine cases.

In seven cases a displaced pacemaker remained from the sympathectomy — in one of these cases, however, only temporarily. A displaced pacemaker, noticed during sympathectomy, became normal in three cases.

In three cases a depression of ST—T or of T was observed. In one patient ST was further normalized.

X. "Oxygen administration and waking up". Twenty-two cases.

An increase in the pulse rate was often seen here, when the depth of the anaesthesia diminished with the supply of pure oxygen.

In four cases a displaced pacemaker disappeared during this stage — in three cases it remained.

The patient who got a bundle branch block in connection with the fall in the blood pressure during the anaesthesia just before operation, was now free from it for the first time.

In seven patients a normalization of ST, ST—T or T occurred. Two of these cases with normalization of ST, and another that showed a depressed ST, had simultaneously an increased pulse rate. Temporary depression of ST was seen in yet another case.

As a rule, these ECG:s were registered during oxygen administration with the tube left in the trachea. However, in two cases they were taken also soon after the tube had been withdrawn. One of the latter showed a relative depression of ST.

XI. "After waking up". Fourteen cases.

During this period there was also often a relative increase in pulse frequency. In three cases that still showed a displaced pacemaker during "oxygen administration . . .", this finding disappeared in one, remained in another. (In the third of these cases, no ECG was registered.) In the days following operation, all the pacemaker changes had disappeared.

In two patients a simultaneous depression of ST—T was noted, and in another two a depressed T wave. In two other cases the T wave became higher.

One case should be reported separately. It illustrates the importance of a careful anamnestic and electrocardiographic examination also immediately before operation.

A man, aged 41, with severe longlasting angina pectoris, and a history of old myocardial infarctions, was subjected to ganglionectomy.

Table 1. *Oxygen Saturation Determination acc. JONXIS.*

Case	Preoperative				During operation	Postoperative				Awake (breathing air)
	Rest	Light anaes-thesia	Deep anaes-thesia	Hypoxia during light anaes-thesia	Light anaes-thesia	Light anaes-thesia	Deep anaes-thesia	Hypoxia during light anaes-thesia	100 % O ₂	
1. H. O. H.	91	90	85	81 ²					88 ²	
10. G. G.	95				93				95	
12. K. E. K.	91	87			89	89				87
14. H. J. S.	92	89	88					88	90 ⁵	
17. O. J. N.	92	91			90	92			94 ⁵	
22. H. J. S.	(91 ¹)		.				96	93	82 ²	96 ⁵
23. M. E. B. ⁶	83 (87 ¹)			77 ²	84	75 ⁴			82	
35. M. A.		90	86		92				94	94
36. J. S. H.	94	99	93		96					
41. O. A. K.	93	89	88						93	
44. E. O. A. N.	93				91					94
D. A.	93	91						90	91	

¹ Sample taken a few days before operation by another investigator.² 4 min. inhalation of 1 l. O₂ + 5 l. N₂O — slight lip cyanosis.³ Intubation — slight cyanosis.⁴ Fall in blood pressure — cyanosis. Pure oxygen administered for 10 min. Pat. later disclosed pulmonary edema.⁵ Administration of pure oxygen for 6–10 min.⁶ "Bad case" (see the text p. 015).

At the very beginning of the operation, a fall in the blood pressure and a sudden pulmonary edema occurred that could not be checked. He died 11 hours after the interrupted operation.

On the day before operation he had some particularly severe attacks of anginal pain. ECG was taken immediately before operation, but not studied before the intervention started. This ECG showed changes consistent with recent myocardial infarction, as compared with ECG recorded earlier. The changes were more marked after intubation and, later, after an increase in pulse rate.

Autopsy showed a recent infarction involving the posterior wall.

The Oxygen Saturation of the Arterial Blood.

The arterial oxygen saturation was determined during anaesthesia (1) in order to check that our maintenance anaesthesia did not produce hypoxemia, and (2) to observe possible relations between changes in the ECG and variations in the oxygen saturation.

It is difficult to maintain a constant oxygen content in the inhalation gas owing, *inter alia*, to errors inherent in the apparatus and administration. When, for instance, a calculated 15 vol.-% oxygen-gas mixture was given, Mc QUISTON *et al.* (1943) observed variations of ± 4 vol.-%. Direct determination of the oxygen content in the blood of the patient will offer the best criterion on the adequacy of the oxygen-gas administration.

Several authors (*inter alia*, BARTON *et al.*, 1946) have investigated the effect of different anaesthetic agents upon arterial oxygen saturation. The results varied, but usually a decrease in oxygen saturation was obtained. This was explained in different ways. According to the so-called "pneumonosis theory", the oxygen unsaturation is caused by an impaired diffusion of oxygen through the alveolar membranes, possibly due to autonomic influence (cp. SVANBERG, 1939). According to KRAMER (1935) the change in respiration during anaesthesia gives rise to the oxygen unsaturation of the blood.

In the present investigations the arterial oxygen saturation was followed during anaesthesia.

We have employed JONXIS' (1943) method for the determinations. Since January 1947, we have used an oximeter constructed in Sweden according to MILLIKAN (1942) (cp. I. LINDGREN (1947)).

Observations with JONXIS' method.

JONXIS' (1943) method was used in twelve instances, with repeated blood-sample analyses, preoperatively as well as under stabilized anaesthesia. See Table I. No samples were taken during the induction of the anaesthesia when oxygen saturation varies rapidly.

As may be seen from Table I, the oxygen saturation during so-called light anaesthesia keeps at a satisfactory level, while during deep anaesthesia it seems to show a tendency towards falling. In two cases a small reduction of the ordinary oxygen-gas content in the inhalation gas (to about 16—17 per cent) caused a distinct lowering of the oxygen saturation of the blood. This was later confirmed by oximetric determinations. As seen from the table, the inhalation even of pure oxygen *after* operation often gave fairly low values as compared with the pre-operative figures, when the patients breathed air.

Observations with the oximeter.

1. At fairly rapid induction with narcotal the ventilation of the lungs was lowered, sometimes even a brief apnoea occurred. The oxygen saturation in the blood decreased markedly (down to 80—85 per cent), though but temporarily.

2. At intubation a reflex apnoea was sometimes obtained, most pronounced during light anaesthesia but seen also in deep anaesthesia. A fairly marked hypoxia (down to 60 per cent) would then often appear, more conspicuous during technically complicated intubations. Even when executed without any difficulty, *i. e.* without cough irritation, etc., the oxygen saturation often declined towards 70 per cent. In these cases, however, the anaesthesia was generally deep with subsequent deficient ventilation.

3. Cough irritation, so-called tense respiration, obstructed air passages, were all accompanied by falling oxygen values. However, usually these rapidly returned to normal after one or two deep breaths of oxygen.

The variations in the oxygen saturation in the above-mentioned conditions are very rapid and hardly observable by *in vitro* determination of the oxygen saturation.

4. The impression (see above) that our maintenance anaesthesia gave a satisfactory oxygen saturation of the arterial blood was confirmed by the oximetric examinations (90—95 per cent oxygen saturation).

5. An obvious slowness in the elevation of the oxygen saturation was often noted in the post-operative administration of pure oxygen (*cp.* above under the heading "Jonxis' method"). This emphasizes the importance of tracheo-bronchial toilette, quick rousing and adequate post-operative treatment. Our control

examinations on patients that were awake excluded the possibility of so-called apparatus' fatigue. Sometimes the oxygen values improved post-operatively after coughing, probably due to changed respiration and simultaneous removal of accumulated mucus.

Thus we were generally able to exclude hypoxia as a factor influencing ECG recorded during our maintenance anaesthesia. In some instances of hypoxemia, mainly those induced experimentally, we were able to correlate hypoxia and ECG changes, *i. e.* those in the ST—T region.

Blood Pressure.

The intravenous administration of narcotal and deep ether anaesthesia have, as a rule, been accompanied by a fall in the blood pressure.

The fall in the blood pressure on narcotal injection was mostly transient (lasting for a few minutes) and, apart from an increased pulse rate, no effect on the ECG was observed.

The effect on ECG of a decreased blood pressure in deep anaesthesia is harder to analyze as many factors are involved. In one case the T wave in Lead II increased during deep anaesthesia with a fall in the blood pressure from 210 to 165. The oxygen saturation was comparatively constant (91 and 87 per cent), but the pulse rate was reduced. In a few cases of deep anaesthesia with only a reduced blood pressure, no changes were noted in the ST—T region. In two other cases T in Lead I "improved" with a simultaneous rise in the blood pressure (from 120 to 170) when the patient was roused. There was a slight increase in pulse rate (from 60 to 75 beats per minute). The oxygen saturation was constant.

No relationship was observed between the blood pressure variations and the occurrence of nodal rhythm. A nodal rhythm was found even in cases of deep anaesthesia without a lowering of blood pressure.

In one instance, a fall in blood pressure was accompanied by a bundle branch block.

Special mention should be made of the changes in the blood pressure manifested in connection with the surgical intervention on the stellate ganglion.

In these instances, often an immediate but transient fall in the blood pressure occurred. In order to avoid this, procaine was later injected into the stellate ganglion. In spite of this, though in only about one third of the cases, an identical reaction occurred when the needle was inserted into the ganglion. The blood pressure might fall from 140

mm Hg down to 80. Several times even the radial pulse could not be palpated for 10—15 seconds. However, after a few minutes the pressure returned to its previous level. In most cases no effect was noticed on respiration and pulse rate. In isolated instances the pulse rate increased for a short while.

Immediate ECG changes were not manifested, as mentioned earlier, at the injection and exposure of the stellate ganglion, not even in a case where the radial pulse was unpalpable.

TSCHERNJACHIEWSKY (1929, quot. GERNANDT) points out that the depressor nerve in cat receives sympathetic fibres from the stellate ganglion. This could have been suspected to play a rôle here. However, stimulation of these fibres give no depressor effect. It is conceivable that afferent impulses, elicited through manipulation with the ganglion, cause a fall of the blood pressure through reflex action (cp. JARISCH and ZOTTERMAN 1948).

Discussion.

The causes of the ECG changes reported are usually very complex.

The importance of variations in arterial oxygen saturation, blood pressure and pulse frequency for the ECG changes has been discussed earlier.

As regards the three items, (A) stimulus formation, (B) conduction velocity and (C) other myocardial influences, our results may be specified as follows.

A. Among disturbances regarding stimulus formation we have frequently come across pacemaker displacement towards the node or to the ventricles. In our cases we have seen a decrease in the frequency of the sinus pacemaker as well as an increase in the frequencies of lower centres. The physiological law is that the part of the heart producing the highest impulse frequency always takes the lead. An interference dissociation is not seldom noticed, which may be erroneously taken for extrasystoles if the pulse is palpated (Fig. 7).

Somewhat in variance with KURTZ *et al.*, we found the tendency towards pacemaker changes to be most pronounced during deep anaesthesia. In deep anaesthesia with unchanged pulse frequency and blood pressure, but somewhat lowered oxygen saturation, the ECG may be influenced not only by the hypoxemia, but also by an increase of the anaesthetic agent. The tendency towards pacemaker changes has seemed to be connected with the presence of the anaesthetic agent rather than with changes in the oxygen saturation.

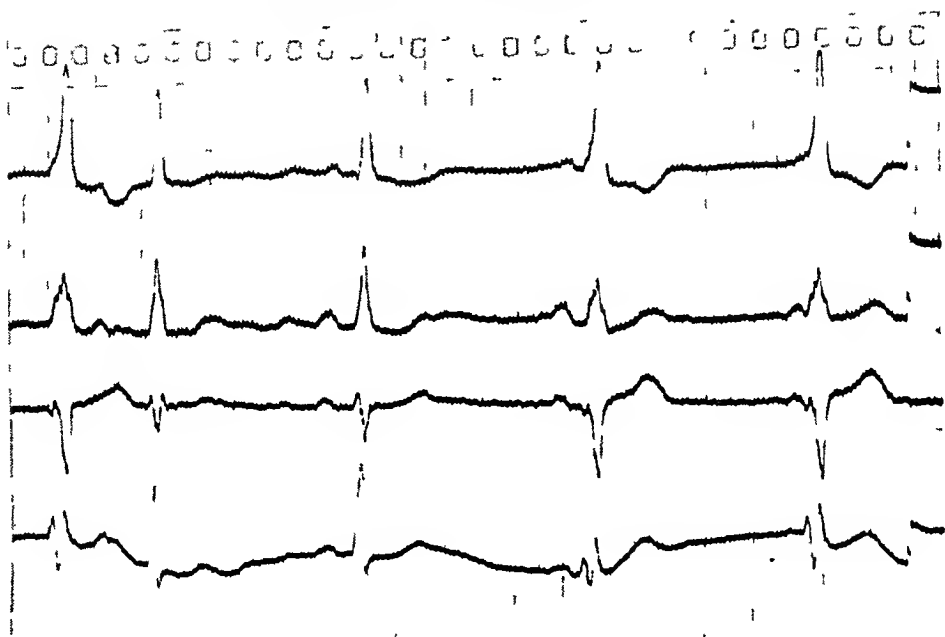


Fig. 7. Example of an arrhythmia that may be clinically misinterpreted as extrasystolia. It appears here owing to so-called interference between the (ordinary) sinus pacemaker and a pacemaker in the ventricles. Only complexes 2 and 3 are "of normal shape". This ECG is recorded during anaesthesia, stage III: 3—4.

Extrasystoles were remarkably rare. This is important since ventricular extrasystoles have been considered to predict ventricular fibrillation. We purposely tried to avoid an increase of the irritability of the myocardium (a) by using ether as the anaesthetic agent, (b) by maintaining a high (controlled) oxygen content and, finally, (c) by avoiding "stimulants" (of the epinephrine type, etc.).

B. Disturbances of the conduction velocity are very rare, observed only in two cases. In one patient, a transient bundle branch block appeared in connection with a fall in blood pressure, and, in another, an A—V block during post-operative anaesthesia.

C. Myocardial influences manifested by changes in the ST—T region, were very frequent. In a further elucidation of the ST—T changes, the use of at least two more chest leads is recommended. The many factors influencing the ST—T region, make an evaluation of this part of the ECG comparatively difficult.

During hypoxemia, changes in the ST—T region often appeared. An increase in oxygen supply was generally followed by a partial or total normalization.

Normalization of the ST—T region, as fairly often manifested during light anaesthesia, may be due to the anaesthetic agent,

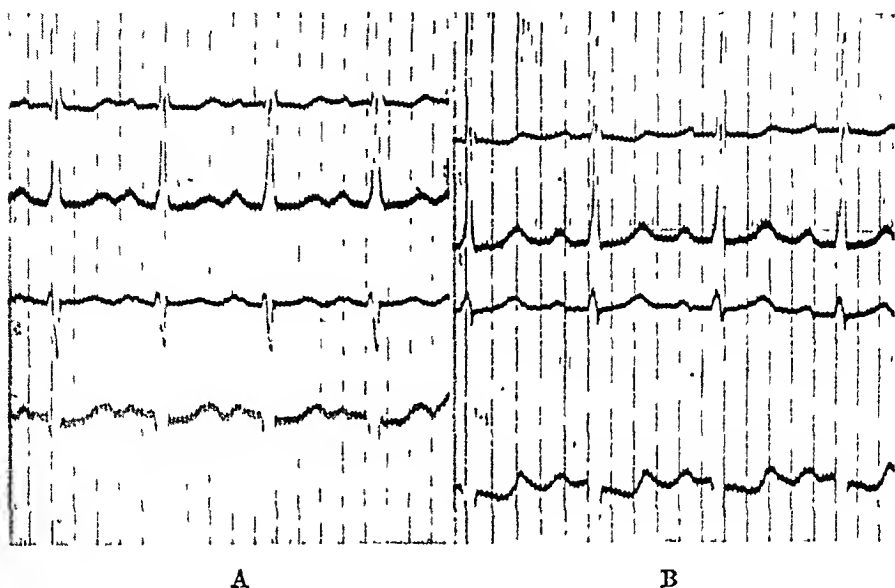


Fig. 8. Example of comparatively slight ECG changes, in spite of large difference in prevailing conditions.

- A) ECG before anaesthesia was started. Systolic blood pressure 250 mm Hg. Pulse frequency 125/min.
- B) Anaesthesia Stage III: 4. Oxygen-gas administered in excess. Systolic blood pressure 90 mm Hg. Pulse rate 115. Irregular, shallow respiration. ECG revealed relative deviation to the right of the el. axis and slightly accentuated depression of the S—T segment in Lead IV R.

the rather high oxygen content in the inhalation gas or, sometimes, to a simultaneous lowering of the pulse rate.

Finally it may be restated that in many cases comparatively small changes in the ECG occur in spite of large differences in the conditions otherwise prevailing (Fig. 8).

Summary.

1. During surgical interventions on the sympathetic nervous system in patients with heart diseases, changes in circulation were studied by observing the electrocardiogram, the blood pressure, the radial pulse and the oxygen saturation of the arterial blood.

2. The different procedures and stages involved in the anaesthesias and operations were studied separately. Certain factors, *e. g.* depth of anaesthesia, oxygen saturation, were varied experimentally.

3. During the cervico-thoracic sympathectomy no consistent changes were noticed in the electrocardiograms. Frequently a distinct, though transient, fall in the blood pressure was seen when the stellate ganglion was mechanically interfered with.

4. The importance of observing the electrocardiograms also immediately before operation on patients with angina pectoris is stressed.

5. A displaced pacemaker often occurs, particularly during deep anaesthesia.

6. Interference dissociation — a “physiological” consequence of a displaced pacemaker — may, at mere physical examination, be misinterpreted as extrasystoles.

7. Extrasystoles were very rare in our cases, probably due to our efforts to avoid them.

8. The appearance of ST—T changes during anaesthesia is comparatively common and may often be explained by simultaneous changes in frequency and by hypoxia. However, at a fall in systolic blood pressure, such electrocardiographic changes are relatively rare.

9. Electrocardiographic changes during intubation seem to be due, principally, to manifested hypoxia.

10. A considerable reduction in the oxygen saturation of the arterial blood is seen at induction of the anaesthesia, but is generally rapidly transient. In some cases there was a lowered oxygen saturation at the end of the operation, emphasizing the importance of tracheo-bronchial toilette, quick rousing of the patient, and adequate post-operative treatment.

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A Case of Habitual Patellar Dislocation Treated by Total Extirpation of the Patella and Tendon- Muscle Plastic.

By

S. ORELL.

The present paper deals with a case of habitual dislocation of the patella treated by total extirpation of the latter. Permanent reposition not being attainable by conservative procedures, surgery had to be adopted. An attempt at operation had been made once before, but had failed to produce the desired result. To ascertain definitely whether the reposition was really successful, it was found necessary to use functional tests during the operation and, on account of advanced chondromalacia, to remove the patella *in toto*.

Mechanic, age 32. In 1932, when practising three-step jumping, he suffered a dislocation of the right patella. Despite the patella returning immediately to the normal position, there ensued considerable swelling and an effusion into the joint. The patient presented himself at an out-patient department, where he was treated with repeated punctures.

Subsequently he was fairly comfortable. At intervals, however, he had a feeling of insecurity and feebleness in the right leg, particularly when leaping, but was able to work without difficulties.

In September, 1944, he fell into a pit 2 metres deep. Also on that occasion the patella was dislocated, but returned immediately and spontaneously to the normal position. The patient went to see a physician, who advised closed wet dressings, rest in bed, and a plaster-of-Paris bandage for 4 weeks; following this, muscular exercise for another 3 months; then the patient was to resume working.

In 1945, when working on a building under erection and there

crossing a plank, the patient stumbled and fell down from a height of about 30 cm. The patella was dislocated as before, but spontaneous reposition took place even then. Once more a swelling developed, and the patient was incapacitated during 3 months.

Lastly, in January, 1947 the patient happened to slip on a plank slippery with ice and fell down, the patella being dislocated in consequence. He reported himself at the out-patient service, where skiagraphs were made on 16/1/1947. *Right knee joint:* The patella is dislocated rather far lateral. Adjacent to the upper portion of the patella a couple of small pieces of fractured bone; a similar piece or two near the upper margin of the lateral femur condyle. The knee joint in general presents fairly considerable evidence of arthritic affection. The patient was admitted to hospital and operated on 7/2/1947. A ligament plastic was performed. The record contains the following statements: The tissue interspersed between the patella and the detached mass of fractured bone is very markedly fibrotic. At the outset it had been intended to remove the detached mass and by sutures attach the ligaments to the patella. However, the tissue is so fibrotic that its brittleness renders it necessary to retain the fractured bone and use it as an anchor. The bone having been released from the surrounding tissue by means of a knife and the medial aspect of the patella uncovered, a couple of holes are drilled through the latter, and the detached bone is affixed with two silk sutures. The ligaments are then sewn on to the upper surface of the detached bone, also with silk. Plaster-of-Paris bandage.

After the operation, however, the patella was still dislocated and could not be manipulated into the normal position. Skiagraphs taken on 14/5/1947 disclosed the following. *Right knee joint:* The patella is dislocated towards the external aspect of the lateral femur condyle, the margins of the articular surface of which show irregular projections. Near the medial margin of the patella a small piece of newly-formed bone is embedded in the soft tissues, and in the apex of the patella, there is a little metal peg. — The joint presents arthritic changes, with lip formation along the margins of the articular surfaces (Fig. 1).

The patient was referred to the Orthopædic Department of St. Göran's Hospital, where he was admitted on 18/8/1947 with the diagnosis, luxatio patellae habitualis dext.

Condition on admission. — Considerable muscular atrophy of the right thigh. Extension in the knee joint incomplete, with a deficit of at least 5 degrees. Position of the patella normal on extension. Flexion of the knee joint regularly results in total lateral dislocation of the patella. If the patella is forcibly retained in the normal position the patient is unable to bend the knee more than 20—30 degrees. There is slight sub-patellar crepitation. The patella being dislocated, motility is unimpaired of the knee joint.

On 27/8/1947 extirpation of the patella and muscle-tendon plastic were performed (evipan-ether). Longitudinal curved incision along the medial margin of the patella. A median incision is made through the fascia covering the patella, and the joint capsule is opened. On examination of the posterior aspect of the patella the cartilage is found to

be considerably extenuated, there being a chondromalacic lesion of about the size of a threepenny piece, and extending as far as the osseous surface, in the cartilage covering the facies patellaris medialis. The incision into the soft parts medial to the patella is extended upwards and downwards. On flexion of the knee the medial portion of the extensor system retains its position fairly well, whereas the lateral portion including the patella, is dislocated lateral beyond the femur condyles. Patella is removed. The area of insertion of the lateral por-



Fig. 1. Axial view of the right knee before operation.

tion of the ligamentum patellae on the tuberosity of the tibia is chiselled off and displaced far medial. On flexion tests now even the lateral portion of the extensor system remains in the correct position. After having been separated from the bone the insertion is affixed beneath the periosteum by strong catgut sutures. The wound is carefully dusted with penicillin-sulfathiazole powder. Suture of soft parts. Fenestrated circular plaster bandage encasing the thigh and leg.

About 8 days after operation the anterior portion of the plaster bandage was removed, and the patient was asked to exercise the extensors of the thigh. The sutures were extracted on the 12th day after operation, the patient being allowed to walk 3 weeks after operation.

22/9/1947. Discharged cured roughly 3 weeks after operation. Flexion of the knee joint, 70 degrees. The patient walks fairly unrestrained and without pain. Ambulatory exercise treatment. On skiagraphic examination (22/9/1947) the following findings were recorded: The patella is absent. The margins of the articular surfaces of the lateral femur condyle show irregular projections as before. At the medial tibia condyle the fresh insertion is visible of the lateral portion of the extensor system. Otherwise as prior to operation (Fig. 2).

30/1/1947. The condition has continuously improved. There is still muscular atrophy. During the past week the patient has done heavy work (clearing away snow), without any difficulties whatever. Exten-

sion deficit now at most 3 degrees. Flexion of the knee joint 145 degrees, equalling the opposite joint.

11/11/1948. From 30/1/1947 onwards the patient has been unrestrainedly active in his former employment, viz. plumbing, bearing loads of up to 60 kg. on stairs, and during the whole summer riding a bicycle, without the least discomfort. Examination discloses neither



Fig. 2. Frontal view of the right knee after operation.

swelling nor tenderness of the knee. Extension is now as satisfactory as in the normal knee, and flexion perfectly normal. There is still muscular atrophy: the right thigh is about 3 cm. thinner than the left, and the right leg about 2 cm. thinner than the opposite one.

The abnormal condition of the knee joint in the above case was thus due to three separate factors, viz. the luxation of the patella, the chondromalacia, and the arthritis deformans. Treatment had to be directed against those three factors.

Dislocation of the patella is as a rule treated by tendon and muscle plastics, according to *e. g.* KROGIUS, GOLDWARTH, etc. In the present instance I contented myself with displacing the lateral portion of the patellar ligament on the tuberosity of tibia

far medial to a spot, which on flexion tests made during operation proved to be the correct one. The aponeuroses and ligaments of the extensor system being markedly fibrotic, a less simple type of plastic could hardly be taken into consideration.

The chondromalacic lesion extended so far downwards that chondrectomy was scarcely to be considered. Chondrectomy is beneficial in those cases only, where the profound portion of the cartilage is normal and covers the subjacent bone. If the necrosis of the cartilage is of considerable depth, and if the bone is denuded at the posterior aspect of the patella, patellar plastic should be carried out, the posterior portion of the patella being removed and the exposed osseous surface covered with joint capsule, parapatellar fat masses, or transplanted fascia lata. This procedure entails the risk of fibrous adhesion, however.

In my opinion total extirpation of the patella, as advised by *inter alia* FRIBERG for various types of chondromalacia, is preferable. On the other hand, the benefit to be derived from total extirpation is dependent upon the joint not being too seriously affected with arthritis deformans.

In the present case the arthritis deformans was rather strongly developed within the femoro-patellar joint, less so in the femoro-tibial articulation. Should the arthritis deformans happen to advance and inconvenience the patient, resection of the knee joint might possibly be resorted to.

A detail of operative technique essential for the functional and cosmetic results is according to FRIBERG, that after the extirpation, which is performed most conveniently with a knife, the quadriceps tendon is sewn on to the patellar tendon, and that the ligamentum praepatellare is doubled in front of this affixture. Thus a more normal appearance is achieved regarding the shape of the knee, and the bed of the patella is covered with tendinous tissue. This is an important point, since osseous or calcareous deposits, which might irritate the joint — particularly as these conditions are usually associated with a tendency towards arthritis deformans — are apt to form in the bed. In the case presented the medial portion of the ligament system was considerably fibrotic and covered entirely the facies patellaris of the femur. The lateral portion of the tendinous system, from which the patella had been removed, by the plastic was carried across and placed in front of the medial portion, for which reason there is scarcely any danger of calcareous deposits forming in this area.

The muscular atrophy may also impede restitution. Very frequently muscular atrophy will improve rather tardily, in extreme instances not until the best part of the second year following operation has elapsed. In my patient, however, muscular force was rapidly re-established, to a large extent owing to the patient's intelligence and energy.

In view of the result hitherto achieved, and on account of the arthritic changes in the joint being fairly mild, I believe that the beneficial effect is going to last in the present case.

Summary.

A case is described of habitual dislocation of the patella and chondromalacia, treated with tendon and muscle plastics and total extirpation of the patella. Permanent reposition could not be effected by conservative procedures, but had to be brought about by surgery. A previous attempt at operation had been made in another hospital but failed to produce the desired result. To ascertain definitely whether the reposition was really successful, it was found necessary to test the function of the joint during operation and, on account of advanced chondromalacia, to remove the patella. The result was satisfactory. Six months after operation the extension deficit amounted to at most 3 degrees, being completely eliminated 1½ years after operation (*i. e.* extension perfectly normal); the flexion was equally satisfactory as in the normal knee, with the muscular atrophy still remaining. For about 1 year after operation the patient has done heavy work as a plumber, without the least inconvenience.

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(Chief: Professor JOHAN HOLST, M. D.)

A Non-classifiable Case of Hyperparathyroidism.

Addendum to the Publication:
Surgical Treatment of Hyperparathyroidism.

By

KAARE LIAVAAG.

In a previous number of *Acta Chir. Scand.* (Vol. XCVII. P. 42, 1948) the author published some cases of hyperparathyroidism, supporting the American concept that parathyroid adenoma or focal hyperplasia and diffuse hyperplasia must principally be regarded as two separate entities, the diagnosis of which depends on the microscopical picture. Later we have had a case which can hardly be conformed within the scope of the above mentioned classification.

This case is a 40-year-old male who for several years had been troubled by rheumatic pains in the knees and elbows. During the last year prior to admission he had severe pain in the left hip. The pain radiated into the left lower extremity, and was so intense that it disturbed his sleep. He was admitted to Tromsø Hospital where the condition was diagnosed as hyperparathyroidism on the basis of laboratory findings. He was transferred to our clinic on August 6th, 1948.

Physical examination revealed a rather thin patient. The pulse rate was 80, the blood pressure 165/100. A nut-sized tumor could be palpated on the left side of the neck corresponding to the lower pole of the thyroid gland.

Laboratory data: Urine: Albumen +. Hb. 89 %. RBC 4.06 mill. WBC 5,800. Alkali reserve 50 vol. %. Blood urea 100 mg %. Sedimentation rate 13 mm. Blood calcium 13.8 mg %. Blood phosphorus 4 mg %. Phosphatase 1.3 Bodansky.

Roentgen examination: Urogram was normal. Roentgenograms of the *skeleton* showed cystic areas of decalcification in both semilunar bones and in the first metacarpal bone of the right hand, and also in

the right medial malleolus. A chest roentgenogram revealed a plum-sized tumor on the right side at the level of the second rib. The tumor caused a displacement of the trachea toward the left side.

A parathyroidectomy was performed on August 12th, 1948. During the operation one hazelnut-sized and one walnut-sized gland were found on the left side, and one hazelnut-sized gland on the right. These



Fig. 1.

were all extirpated. All the glands were examined microscopically, and the same and a quite uniform picture was obtained showing the characteristic hyperplasia of the water-clear cell type (Fig. 1).

The postoperative course was uneventful. However, the operation had no effect on the calcium metabolism, and the high blood calcium persisted, varying from 13 to 16 mg %. It was assumed, therefore, that the tumor which could be seen on the roentgenogram was an intrathoracic hyperplastic parathyroid gland. For this reason the patient was re-operated on September 13th, 1948. A *mediastotomy* with *extirpation of the tumor* was performed. An encapsulated tumor the size of a chicken egg was found in the posterior part of the mediastinum on the right side close to the vertebral column. The tumor was extirpated. The microscopical appearance of this tumor was entirely different from that of the removed cervical parathyroids. Some areas showed a diffuse hyperplasia of clear cells. These cells, however, were considerably smaller than those encountered in the removed cervical parathyroids. Neither was the microscopical structure of the thoracic tumor characteristic of a parathyroid hyperplasia (Fig. 2). In other areas the cells were still smaller and not clear and had the appearance of young chief cells. The microscopical structure, too, was different, resembling that of a focal hyperplasia (Fig. 3).

A paresis of the recurrent nerve occurred as a result of the operation. The blood calcium fell successively to normal and subnormal values. The lowest value encountered was 5.3 mg %. Evidence of a permanent

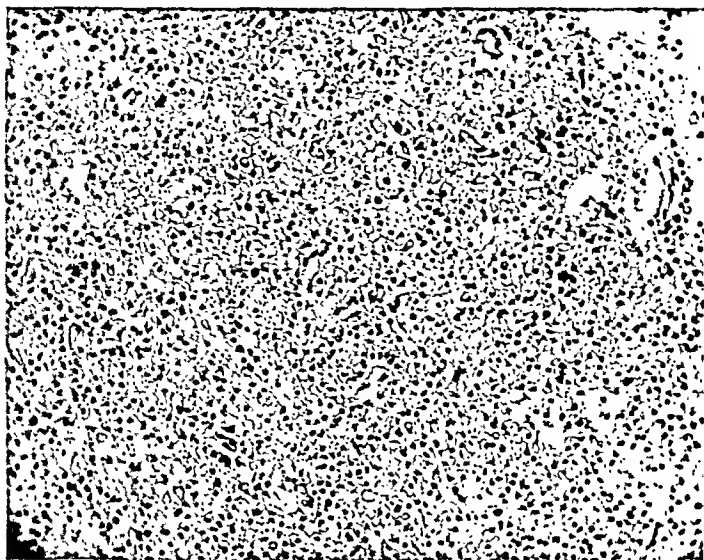


Fig. 2.

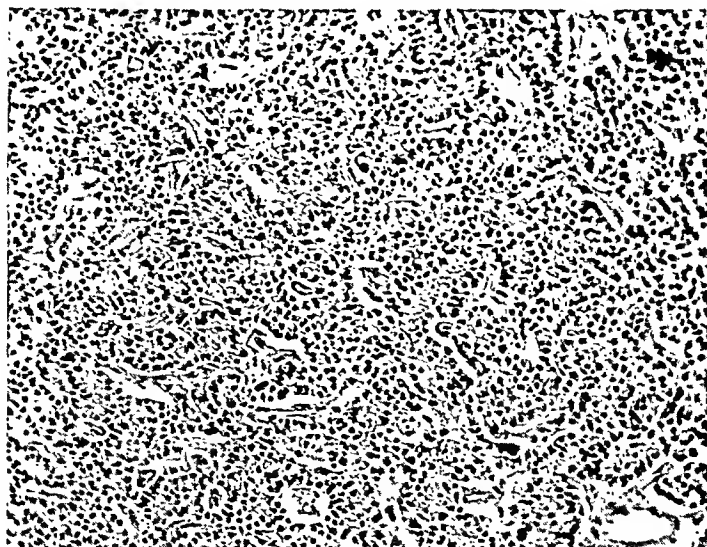


Fig. 3.

tetany developed, and calcium and A. T. 10 medication had to be instituted. This treatment is still being continued. However, subnormal blood calcium values (6 mg %) have persisted despite this treat-

ment. Most likely too much, perhaps all, parathyroid tissue has been removed at the operations.

This case presents several interesting features. Firstly, the case shows that in the presence of a diffuse parathyroid hyperplasia this may be confined to aberrant parathyroid tissue also. Secondly, the case shows that a diffuse hyperplasia and an associated hyperparathyroidism may be present without hyperplasia of the water-clear cell type being present in all the parathyroids. If in this case, only the mediastinal parathyroid gland had been removed and examined, it would no doubt have been interpreted as an adenoma. However, the interpretation of this case is a puzzle. There are two theoretical possibilities: 1) The patient has had an parathyroid adenoma located in the mediastinum, and hyperplasia of the cervical parathyroids. This view is not, however, compatible with the usual conception, which is that an adenoma of one parathyroid usually causes an inactivation of the remaining glands. In those cases where one has had the opportunity to examine one or several of the other parathyroids in a patient with adenoma, these glands have been normal except in cases with a far advanced renal insufficiency where a hyperplasia of the other parathyroids may be seen. However, the microscopical picture in these cases is different from that of a hyperplasia of the water-clear cell type.

2) The other possibility is the presence of a diffuse hyperplasia of the water-clear cell type of the cervical parathyroids, whereas the hyperplasia of the aberrant mediastinal gland has been of a mixed type. In this gland there are isolated areas of hyperplasia of smaller water-clear cells. The structure, however, is not typical for a water-clear cell type hyperplasia, and other parts of the gland show a hyperplasia of young chief cells. Further, the structure in these areas corresponds to that of an adenoma of the chief cell type. This view to a certain extent contradicts the strict American differentiation between adenoma and hyperplasia. A theoretical question of considerable interest is whether the patient's impaired renal function (cf. the increased blood urea and the comparatively high P values) has contributed to the microscopical appearance of the parathyroid towards that encountered in case of secondary nephrogenous hyperplasia. However, it is difficult to see why this change should be confined to a single gland only.

To the author's knowledge no similar case has been reported

in the literature. As no adequate explanation can be given to the case from our present knowledge, the intention of this paper is merely to register the case.

The case does not, however, alter the conclusions reached regarding the operative treatment, although in this case it would probably have been advantageous to have started with removing the mediastinal gland.

Summary.

The author reports a case of hyperparathyroidism. Three enlarged cervical parathyroids were removed and all showed the characteristic hyperplasia of the water clear cell type. No clinical improvement occurred following the operation. The patient was then re-operated and an enlarged parathyroid situated in the mediastinum was removed. The microscopical appearance of this gland was entirely different from that of the removed cervical parathyroids. Some areas showed a hyperplasia of smaller water-clear cells, whereas in other areas there was hyperplasia of young chief cells. The case does not conform with the usual conception of adenoma and hyperplasia, and the problem regarding its interpretation is briefly discussed.

From the Surgical Clinic, Lund.
(Chief: Professor J. P. STRÖMBECK, M. D.)

Combined Pre-Operative Thiouracil and Lugol Treatment in Thyrotoxicosis.

By

STIG BORGSTRÖM.

It must be a matter of common experience that the non-iodine resistant cases of hyperthyreosis are got into operation order more rapidly through iodine than through thiouracil treatment (HOWARD, 1945). From a technical point of view the operation is easier, when the patient is treated in advance with preparation of thiouracil (SAVINI, 1947); the peristritumitis is not so pronounced, the gland firmer and bleeding less easy. If the preparation of thiouracil be given pre-operatively, it is generally the custom, at least in diffuse toxic struma, to break off this medication 2 weeks before a projected operation and during this period only administer iodine (BOTHE, 1947). If this method of treatment were in general use, the period of pre-operative treatment would be longer than with only administration of iodine, as 10 days—3 weeks is the accepted period for getting a patient into operation order (COLE, 1941, 1944; HOWARD, 1945).

In the Lund Surgical Clinic, from June, 1947, the pre-operative iodine treatment in cases of hyperthyreosis has been combined with a simultaneous thiouracil treatment. This was done in order to find out whether this combined treatment could in any respect be shown to be more advantageous pre-operatively than iodine medication alone.

Three points will be especially emphasized in this survey:

- 1) The length of the pre-operative treatment.
- 2) Bleeding conditions in connection with the operation.
- 3) The post-operative reaction.

Table 1.

	Pre-operatively treated with			
	Lugol		Thiouracil preparation + Lugol	
	Struma toxica diffusa	Struma toxica nodosa	Struma toxica diffusa	Struma toxica nodosa
Number of cases	25 (21♂;4♀)	4 (4♀)	29 (25♂;4♀)	6 (6♀)
Average age	41 years	44 years	39 years	55 years
Toxic symptoms.....	9.9 months		11.5 months	
B. M. R. before treatment ...	+ 47 %	+ 53 %	+ 49 %	+ 33 %
Pulse rate before treatment..	99	100	98	89
Treatment before operation ..	16.8 days	13 days	18.9 days	16 days
B. M. R. after treatment....	+ 15 %	+ 21 %	+ 14 %	+ 18 %
Pulse rate after treatment...	80	85	75	73
Pulse rate day after operation	111	108	106	105
Temp. day after operation...	38.5°	38.6°	38.5°	38.6°
Quantity of thyroid removed .	43 g	110 g	47 g	96 g

Material.

The composition of the material is seen in Table 1. It embraces 64 cases of toxic struma, which were operated at the Surgical Clinic over a period of 16 months, namely June, 1947—September, 1948. Amongst these, however, those having received any kind of iodine medication during the period immediately preceding admission to the clinic have been excluded. Roughly every second patient in question has received thiouracil and iodine treatment pre-operatively, and every other only iodine.

These latter have served as control material. There has been no selection concerning which kind of pre-operative treatment each individual patient should have.

Propylthiouracil has been used in doses varying between $0.025 \text{ g} \times 2$ — $0.10 \text{ g} \times 6$ per day for thirty out of thirty-five patients, who had received thiopreparation. The 5 remaining patients have received methylthiouracil in a dosaton varying between $0.10 \text{ g} \times 1$ — $0.10 \text{ g} \times 6$ per day. Iodine has in all cases been administered in the form of Lugol's solution with an initial dose of $5 \text{ dr.} \times 3$ rising to at most $15 \text{ dr.} \times 3$ per day.

Pre-Operative Treatment Period.

In 18 of 35 cases receiving thiouracil preparation and Lugol's solution, iodine was only administered on the days immediately

preceding the operation, on an average for 9 days. The total pre-operative period of treatment for these 18 cases is on an average 21 ± 1.5 days. For the remaining 17 cases, who thus simultaneously received both Lugol's solution and thiouracil preparation during the whole pre-operative treatment period, this becomes on an average 17 ± 1.3 days. The difference in pre-operative treatment period for both these groups constitutes 3.4 ± 2.0 days and is thus not statistically guaranteed.

If we again glance at the control material, in which only Lugol's solution is given pre-operatively, the treatment period for these 29 cases becomes 16 ± 1.1 days.

Thus no difference is found in the pre-operative treatment period for those cases in which only Lugol's solution was given, and in which this was combined with thiouracil treatment right up to the operation. On the other hand, the treatment period is probably longer in those cases which have first received thiouracil preparation and Lugol's solution, and then during the period immediately preceding the operation only Lugol's solution, compared with the control material. This difference is 4.7 ± 1.89 days ($\sigma = 2.2$). It is not statistically guaranteed but probable.

Bleeding Conditions in Connection with Operation.

If the technical difficulties are compared which meet the surgeon in the struma operation, in which thiouracil treatment has been employed, with that in which Lugol is given pre-operatively, it is, as has been previously pointed out, the increased vascularization after the former treatment, which above all renders the operation more difficult. Does this increased difficulty arise, even if the Lugol treatment and thiouracil treatment be given simultaneously? It would have been possible to have obtained, up to a point, an objective registration of this by determining and comparing the loss of blood at the operation after the different kinds of pre-operative treatment. As determinations of this kind were, however, not carried out, conclusions must be drawn from the subjective judgements given in the account of the operation. Thus we find that in 6 of 22 cases (21 %), in which only Lugol was given pre-operatively, it is stated that the thyroid gland was vascular or that difficulties with the stanching of the blood occurred. Corresponding figures for those receiving thiouracil and Lugol treat-

ment simultaneously and then only Lugol on the days immediately preceding the operation, are 8 out of 18 (44 %) and for those receiving combined treatment during the whole pre-operative period, 8 out of 17 (47 %). Thus these figures would appear to favour the view that in spite of iodine being administered simultaneously with thiouracil treatment the thyroid gland is not brought into such a technically easy operative order as with Lugol treatment alone. Furthermore, it is possible to suppose from this that the administration of iodine on an average during 9 days after thiouracil and iodine treatment is too short a time clinically to facilitate the operation in respect of bleeding conditions. (To 8 cases in this group, where in the account of the operation the richness of vessels or difficulties with blood stanching had been emphasized, Lugol's solution had only been given 4 to 15 days before the operation with an average of 9 days, thus the same average as for the entire group under discussion.)

Furthermore, the difficulties of blood stanching after this form of treatment are stressed, as we find that post-operative bleeding occurred in 2 cases among the 17 cases, which had simultaneously received thiouracil and iodine during the whole of the pre-operative treatment. Both cases were operated by an experienced and conscientious surgeon. In the one case bleeding came 4.5 hours after the end of the operation, in the other after 1 day. An immediate second operation was undertaken in both cases with a successful outcome.

Post-Operative Reaction.

As a routine treatment all patients have received Lugol's solution in 5 % glucose subcutaneously on the day of the operation and iodine in decreasing dosaton during the days immediately following. Among the 29 patients who pre-operatively had only received iodine, it is mentioned in 3 cases in the journal that the post-operative reaction was considerable. All these 3 cases had a diffuse toxic struma. In no case treated with thiouracil preparation was the post-operative reaction so powerful that comment on it in the journal was considered justified. A more objective measure of the post-operative reaction should be obtained by the pulse rate the day after the operation. In Fig. 1 a comparison is made between the pulse rate before the patients received any treatment and the pulse rate on the day after the operation. If

a survey is made of all cases receiving thiouracil pre-operatively, it is found that 71 % of these have on the day after the operation a pulse rate lying between ± 15 pulse beats in relation to the number of beats before initiation of the treatment. The corresponding figure for those cases treated with Lugol is 55 %. An increase of cardiac action with more than 15 beats a minute cal-

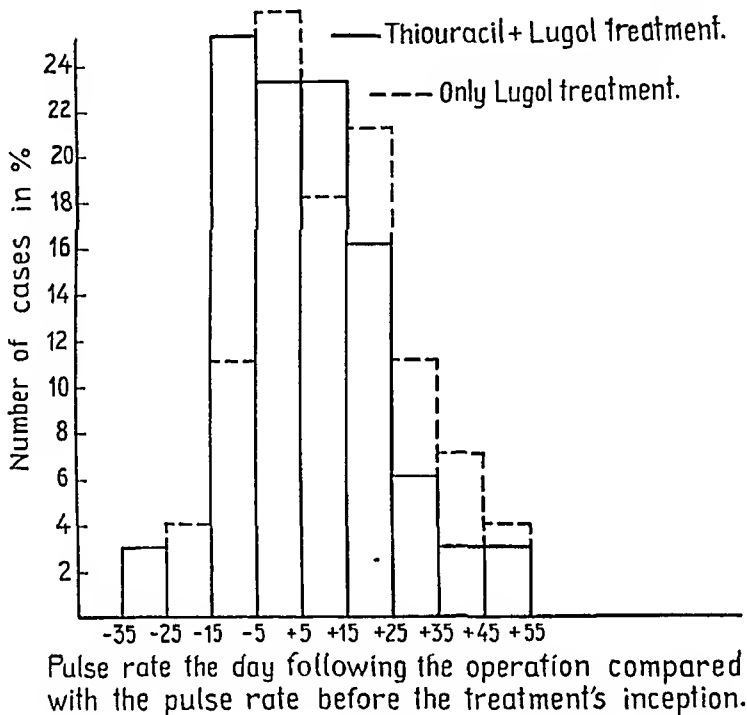


Fig. 1.

culated in a corresponding manner reveals 28 % of those treated with thiouracil and 43 % of those cases treated with Lugol.

If the cases treated with thiouracil are divided up into those who have received this remedy simultaneously with Lugol during the entire pre-operative treatment period, and those who have only had Lugol's solution on the days immediately preceding the operation, it is found that the pulse rate for the former group on the day after the operation is 107 ± 2.6 beats of the heart per minute, for the latter group 104 ± 3.4 . The corresponding figure for the cases only treated with Lugol is 111 ± 3.1 . No statistically guaranteed or in the least probable difference of heart rate on the first day after the operation has thus been able to be shown within the groups under discussion here.

Summary.

The material embraces 64 cases of toxic struma. Of these 29 have received pre-operatively only Lugol's solution; 18 have received thionracil preparation and Lugol's solution simultaneously, and the days immediately preceding the operation only Lugol's solution, and 17 cases have received simultaneously Lugol's solution and thiouracil preparation during the entire pre-operative treatment period. As the material is so comparatively limited, conclusions must be drawn only with the utmost care. It has, however, not been able to be shown that a pre-operative combined Lugol-thiouracil treatment in cases of a non-iodine resistant thyrotoxicosis is superior to the pre-operative Lugol treatment. The pre-operative treatment period is not shortened; on the contrary, it is probably prolonged. From the technical side of the operation the control of bleeding causes considerable difficulties. The post-operative reaction cannot be said with any great degree of certainty to be less pronounced.

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(Chief: STURE RÖDÉN, M. D.)

Postoperative Emptying Difficulties Following Gastric Resections.

The importance of sutural technique in connection with this,
illustrated by means of two series of clinical experiments.

By

STURE RÖDÉN.

The majority of surgeons find that emptying difficulties following gastric operations are rather common though as a rule anxiety is not too great. As often as not they pass over fairly quickly when treated by conservative methods. They are very unpleasant for the patient however, and are troublesome and difficult nursing problems. The problem is touched upon in almost every book dealing with gastric surgery. PERMAN (1935) and BRUUSGAARD (1946) both go rather deeply into the matter in their extensive works. BRANDBERG (1945), RINGDAL (1946) and IVAR SANDBERG (1947) deal solely with this problem.

The many existing descriptions of operative technique are often very detailed regarding the sutural technique which is employed when closing the duodenal stump, but not when it concerns gastroenterostomy. The fundamental claims that serous surfaces should be brought into contact with each other can be achieved in many ways, and it would seem from the literature that it doesn't really matter which method is employed.

One, two or three rows of sutures may all be used with good results. The suturing may be continuous or interrupted, with catgut or silk (FINNEY and HANRAHAN, GORBRANDT). Preferably not silk, except in seroserous suture, as, according to GULEKE,

1927, it entails a risk of cutting through. A continuous suture gives better hemostasis and is more rapidly carried out. Many consider, that the interrupted suture is more certain because, if a suture breaks, only one of them gives way. A *sine qua non* for good results with interrupted sutures is a very thorough arrest of hemorrhage.

As pointed out above, the fact that emptying conditions can depend upon numerous factors but not on sutural technique has been widely discussed. Questions such as the significance of trauma caused by anesthesia and operation, the position, size and direction of the gastroenterostomy, the length of the loops, the condition of longitudinal contraction in the loop, the significance of damage to nerves, the rôle played by infection, membranous necrosis, swelling, shrinking of the mesocolon etc. etc. have all been discussed in numerous works in which many and various opinions and hypotheses have been propounded.

Despite this our knowledge of the subject is actually rather scanty. The object of this paper then is an endeavour to establish some solid foundation for at least one detail in this important region — which can also be extended to enteroanastomosis in general. A generally accepted reason for obstacles in emptying is swelling of the gastroenterostomy itself, a swelling which is caused by stasis, slight infection, irritation of necrotic tissular parts etc. If there is a continuous suture, especially one passing through several layers of the wall, the length of the suture sets an absolute limit to the stretching possibility of the stoma. On the other hand, interrupted sutures make possible a stretching of the greatest part of the tissue lying between the sutures.

I have endeavoured to illustrate this theoretic reasoning by means of two clinical series of gastric and duodenal ulcers which are in no way different from each other except from the point of view of suture technique. They include all the cases that I have personally operated on at the Karolinska sjukhuset from September 1943. When I began with the first series, I had operated on considerably more than one hundred stomachs in accordance with Billroth II (POLYA-REICHEL). I had reached a standardized technique which was sufficient for the majority of cases, and I seldom performed a "Resektion zur Ausschaltung". The resection was made approximately in the middle of the corpus, and a retrocolic, anisoperistaltic terminolateral gastroenterostomy with a short loop was placed to two thirds, or in narrow stomachs to

three quarters, of the gastric cross section situated nearest to the lesser curvature. In individual cases to the whole cross section and very seldom an antecolic gastroenterostomy. Two rows of continuous sutures were used, one passing through all the layers of the wall and one through the serosa and about half of the muscle. No gastric drainage with a duodenal tube was resorted to other than when there was a suspicion of emptying difficulties or vomiting.

All cases are accounted for in the table. The word "vomiting" here implies a loss of gastric content from vomiting or from the use of a tube amounting to 100 ml or more after the amount of fluid that has been drunk has been withdrawn.

Series two, which was begun in November 1946, has in every respect been treated in the same way with the sole exception that two rows of interrupted silk sutures were used instead of continuous catgut sutures. They were placed in the same manner in the different wall layers, the deep lying ones having an internal distance of 10—12 mm from each other and the superficial ones from 8—10 mm.

The first series (continuous sutures). Comprises 57 cases. The only fatal case occurred in this series. (A 32-year-old nursing orderly who, with the exception of a lengthy gastric anamnesis had a clear medical history sheet. He vomited 550 gms in two days after the operation and died suddenly from heart failure the following day. The post mortem showed chronic endocarditis accompanied by vitium aortae; examination of the field of operation showed nothing remarkable.)

The second series (interrupted sutures). Comprised 51 cases. To all intents and purposes both series are equally large. In the first series 20 patients vomited in accordance with the definition given above totalling 110 days and 104 litres. The figures for the second series are: 10 patients, 20 days and 24 litres. In each series there is one case having extremely persistent vomiting and great losses. The first one was reoperated after 37 days, when was found a markedly swollen mucous mass in the stomach plus a shrinking of the mesocolon; the retrocolic gastroenterostomy was replaced by an antecolic following which emptying difficulties disappeared. In the second series — in the last case for that matter — a 37-year-old man lost 17.8 litres in 7 days, after which the whole dissolved. X-ray showed no gastric dilatation but a complete obstruction in the gastroenterostomy. Most probably there was

a severe swelling; he had a pronounced gastritis with rather profuse leucocytes on the surface of the mucous membrane and in the lumen of the glands together with a marked hyperplasia. If one eliminates these two extreme cases from the two series we have: in the first series, 19 patients who vomited for 75 days and lost 56 litres, and in the second series 9 patients, 13 days and 6.7 litres.

If, when reviewing both series, one takes for granted that an allowance of one day's vomiting may be made on account of anesthesia and operative trauma etc., we find that 16 cases vomited in the first series and two in the second. If we examine the amount of fluid lost and eliminate those who have lost less than 300 gm we find that all 20 cases remain in the first series and 4 in the second. Despite the rather small size of the series, the difference ought to be fully established.

With regard to indications, classification of the various ages and sex, there are no differences of importance. Pre- and post-operative care, in which the most important factors are early rising, the control and care of water, electrolyte, hemoglobin and albumin balances, has undergone as little change as is the case with anesthesia. As I previously pointed out my technique at the beginning of the first series was thoroughly trained and standardized and this has perhaps improved somewhat. At all events the time needed for the operation has on the average been reduced from 70 to about 60 minutes from beginning to end. From the table, however, it appears that the change came about immediately after the rearrangement of the technique, for which reason it cannot be explained by increased personal skill. Nor can the change over from catgut to silk be thought to play any rôle in this respect.

One or two X-ray experiments were made in order to follow the variations in the amplitude of the stoma by placing a stainless steel suture at the beginning and end of it but owing to technical difficulties connected with the taking of the pictures no positive results were obtained from the experiments.

What was done in this investigation was to experiment with a clinical material having only one changeable factor. This was done in order to be able to gain a firm foothold in the diffuse basis of knowledge which hitherto we have had at our disposal concerning these questions. As far as I have been able to gather, such a method has scarcely ever been used in this form before, and it is

suggested, that it could be used advantageously within many fields, and perhaps be the means of creating a more exact clinical investigation.

Summary.

The author points out the uncertainty now prevailing concerning the causes of postoperative emptying difficulties. He shows a method, which has not previously been tried for getting positive information about the significance of these difficulties, by means of a clinical experiment with only one factor changed.

Gastric and duodenal ulcers have been operated on in accordance with POLYA-REICHEL, using a continuous suture in gastroenterostomy in the first series and interrupted sutures in the second series. The emptying difficulties are twice as common and much more persistent and greater in the first series than in the second.

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A Case of Delayed Rupture of the Normal Spleen.

By

TORSTEN UNGERSTEDT.

The most frequent of traumatic injuries of the abdominal viscera is rupture of the normal spleen. MAZEL (1932) mentions a frequency of 30 %, BRONAUGH (1935) 35.5 %, WRIGHT and PRIGOT (1939) 47.6 %. According to the latter traumatic liver injuries rank next in frequency with 28.6 %.

The usual course is that the patient is subjected to a blunt force hitting the left side of the abdomen, the back or the lower left half of the thorax, generally when falling from some height or in a traffic accident. The trauma causes rupture of the capsule and laceration of the spleen with a sudden hemorrhage in the abdominal cavity accompanied by more or less pronounced pains and symptoms of intraabdominal bleeding.

A less usual but more insidious and fatal course is taken by the so called delayed splenic rupture, in which case the trauma is accompanied by a period without any or with only insignificant symptoms before the hemorrhage starts. This form is said to constitute about 15 % of the total number of splenic ruptures.

There can be three forms of pathologic-anatomical changes of the spleen:

1) an insignificant superficial rupture of the capsule with little bleeding,

2) a subcapsular hematoma with subsequent rupture of the capsule and suddenly ensuing intraperitoneal hemorrhage,

3) a slightly bleeding rupture of the capsule and parenchyma with capsular perisplenic hematoma subsequently discharging into the free abdominal cavity.

Some time ago a case of delayed rupture of the spleen was treated at the surgical department of Eskilstuna Hospital which might be worth mentioning.

No. 1966/48. Male patient 52 years old. In 1917 patient suffered from malaria with attacks of fever, about one month. Afterwards transient symptoms of polyarthritis with pains in and swelling of the joints. Has been well since and fit for work. Previously no stomach troubles. On 8.9.1948 when occupied with house-painting out of doors, patient happened to fall from a ladder (height of fall abt. 4 1/2 m.). He reached the ground feet first and fell backwards hitting his back against a concrete sole. He felt dazed and complained of transient stitch in the loin. After 5 to 10 min. he could resume his work. For some time after patient suffered intermittently from poignant pains and stitch in the left side of the loin but was otherwise totally without complaints. On 11.10 at 5.30 in the morning, patient was suddenly taken weak and ill when defecating. The feeling of stitch in the left side of the loin and hypochondrium returned and increased, gradually accompanied by pains all over the abdomen radiating towards the left shoulder region.

The same morning patient applied to the med. dep. of this hospital but was subsequently removed to the surg. dep. On his entry he was slightly affected with pallor of the skin and accelerated respiration. Temp. 37°. Pulse 90. Blood pressure 95/60. Hb 64 %, red corp. 2.9 mill., white 21,000. Cor: 0. Pulm.: 0. X-ray showed no free gas. Ekg normal. Abdomen: Tenderness and defense all over the epigastrium, most pronounced in the left hypochondrium. The patient was under observation for a couple of hours, but as his condition deteriorated on the whole, laparotomy was performed (WAHREN). Profusion of blood was found in the abdominal cavity. Liver and mesentery: no remark. On palpation of the spleen a rupture was found. The spleen was removed by a left-sided oblique incision.

A closer inspection of the extirpated spleen showed that its size was 6 × 11 cm. The splenic capsule, being brilliant and glabrous showed several ruptures at its surface, the largest abt. 5 cm long at the hilus, opening into a subcapsular cavity filled with coagula. A histological investigation showed that the splenic parenchyma in the vicinity of the ruptures was interspersed with fresh hemorrhages, constricting the pulp. All demonstrable hemorrhages seemed to be of the same date. Besides the pulp was exsanguinated and rich in cells. Malarial pigment could not be demonstrated. Arterioli seemed to be hyalinized in some places.

Patient recovered fast after the operation and was discharged 11 days later, healed by first intention. Blood inspection showed then Hb 70 %, red corp. 4.1 mill., white 16,400.

According to ZABINSKI-HARKINS who compiled from literature and treated 177 cases of latent splenic rupture, this syndrome is the most usual in men between the ages of 20—30. In our case the latent period lasted about a month, which is very rare. Ac-

According to ZABINSKI-HARKINS the length of this latent period varies in 50 % of all cases from a couple of hours to one week at the utmost and in 25 % from one to two weeks. Only in about ten of the cases described it has lasted from one to several months.

The dominating symptoms during the latent period are usually abdominal troubles varying from unlocalized slight pains in the abdomen to colicky or more permanent pains in the upper left quadrant. General symptoms of hemorrhage such as increasing fatigue, pallor and a tendency to faint have been observed but are not usual before the secondary hemorrhage starts.

Complicated injuries may occur simultaneously and add to the confusion of the picture and complicate diagnosis. Thus, according to DE MONIE, costal fracture occurs in 10 % of all cases, which may give rise to the most conspicuous pains during the latent period. Simultaneous injury of the left kidney or intrathoracic hemorrhage and left-sided pneumothorax as well as rupture of the mesentery with the formation of hematomae have also been observed.

The start of the secondary hemorrhage entails a series of characteristic symptoms, as a rule appearing abruptly but sometimes more insidiously. The releasing force may be an insignificant muscular exertion such as a straining or heaving movement or a violent turn of the body, but in most cases no exterior cause can be demonstrated. Patients receive pains of varying intensity, as a rule localized to the left hypochondrium or epigastrium, in exceptional cases to the whole abdomen. Radiation of pains to the left shoulder region due to irritation of N. phrenicus (Kehr's sign) is not unusual and occurs in 28 % of all cases according to ZABINSKI-HARKINS.

Objectively increased abdominal tension and tenderness are found, the maximum of which is not necessarily localized in the splenic region. As a sequel to the hemorrhage shock ensues very soon. Temperature normal or subnormal. Investigation of the blood shows hemorrhagic anemia and leukoeytosis.

An X-ray survey of the abdomen is of great value to diagnosis and may disclose the following changes:

- 1) increased density of the upper left quadrant of the abdomen,
- 2) upward displacement of the left diaphragm vault,
- 3) ventricle displacement to the right,
- 4) free fluid between the intestinal loops.

The diagnosis of ruptured spleen is usually difficult, not the least because the original trauma can be so insignificant as to be easily overlooked. The most common mistakes are: perforated ventricular or duodenal ulcer, appendicitis-peritonitis, acute pancreatitis, pneumonia and cardiac infarction.

If diagnosis during the latent period is uncertain, patient should be kept in bed under severe observation with repeated blood controls daily. As soon as signs of secondary hemorrhage appear, patient should immediately be operated upon. In such a case only splenectomy should be resorted to. Tamponade and splenography have been performed in some cases but are insecure and entail higher mortality.

In those cases of splenic rupture where no operation has been performed, mortality varies in different combinations from 70 to 100 %. According to MC INDIE (1932) mortality in splenectomized cases was 27 %. According to ZABINSKI-HARKINS' compilation one decade later, this figure has sunk to 10 %, probably to be ascribed to improved diagnosis and more effective pre- and postoperative treatment.

Summary.

A 52 years old man fell from a ladder hitting his back against a concrete socle. One month and three days later he was suddenly taken ill when defecating.

On admission to hospital he showed signs of intraabdominal bleeding and operation revealed rupture of the spleen.

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Surgical Treatment of Patent Ductus Arteriosus.

By

KAARE LIAVAAG.

Ductus arteriosus normally closes shortly after birth. After eight months 98 % have closed (CHRISTIE). If, by the end of a year the ductus has not closed, it usually remains open. Occasionally, however, it can close later in life (SHAPIRO). Patent ductus arteriosus is not an uncommon anomaly. One must distinguish between two types. In certain cardio-vascular anomalies a patent ductus is an important anastomosis between the two circular systems. By short circuiting the blood outside a stenosed aorta or pulmonary artery a patent ductus can make circulation possible through both the systematic and the pulmonary vessels. These cases cannot, of course, be surgically treated. A surgical closure of the ductus would here be directly harmful. A second group is the patent ductus without any other lesion. It is the latter group which is of surgical interest.

What, then, are the results of a patent ductus? After birth the blood flows from the aorta through the ductus to the pulmonary artery. In other words an arterio-venous fistula is formed. In order to compensate the reduced flow of blood to the periphery the stroke volume must be increased. This results in hypertrophy of the left half of the heart, and sooner or later it can result in cardiac failure. In addition to this comes the violent blood stream from the aorta which has a traumatic effect on the pulmonary artery and causes a thickening of the intima with formation of atheromatous plaques. It is these which become the

seat of bacterial infection, which is the other complication which threatens these patients. In a few cases an aneurysmal dilatation of the ductus may be formed, MACKLER and GRAHAM have reported 29 cases.

In order to be able to decide which patients one should operate, one must know what their fate would be without operation. The figures presented by ABBOTT and BULLOCK, JONES and DOLLEY show that there is a higher rate of mortality which can be traced back to cardiac failure and endocarditis. It therefore seems logical that surgical ligation or division of the ductus should be indicated.

The symptoms which a patent ductus arteriosus can provoke, can shortly be summed up as follows: Increased lassitude, often the child is unable to take part in games like other children, dyspnoea, palpitations and occasionally syncope. Physical examination may reveal the following: subnormal weight and physical underdevelopment (this, however, does not seem to be a frequent sign), tachycardia, continuous systolic and diastolic murmur in the second left interspace (this so called machinery murmur is probably the most certain diagnostic sign of a patent ductus), palpable thrill, increased pulse pressure with a low diastolic pressure. When the patent ductus is complicated by endocarditis, this will of course dominate the picture.

The electrocardiogram is usually normal. By means of phonocardiography the continuous murmur can be recorded.

Heart catheterization may reveal a left to right shunt.

Roentgen Findings: The heart may be enlarged, usually the left half of the heart, bulging of the pulmonary conus, straight left border of the heart, increased pulsation of the pulmonary arteries — the so called "hilar dance" — and pronounced lung markings. In clinically doubtful cases good use can be made of arterial aortography using Radners technique of a retrograde introduction of a catheter via the brachial artery. By this means one can visualize the filling of the ductus.

Surgical treatment. The first successful closure for a patent ductus arteriosus was carried out by GROSS in 1939. The theoretical grounds for the operation should appear quite logical, because by ligating the ductus the arterio-venous shunt is stopped. GROSS gave the following indication for an operation: 1) Physical underdevelopment. 2) Signs of heart failure. 3) Reduced voluntary activity. 4) Suspicion of an extra large shunt. Since TOUROFF

showed that, in the presence of endocarditis, the peripheral blood could be made sterile by ligating the ductus, active endocarditis has also become an indication for operation. The extent to which patients not displaying any subjective clinical symptoms should be operated upon, has been a topic for discussion. Opinion, however, tends to run more and more in the direction that operation is indicated also in these cases as a prophylactic measure. In other words: Operation is indicated in practically all cases where the ductus occur alone, the only exception being that of old patients who have few or no symptoms.

GROSS made his first operation through an anterior incision in the third interspace, dissected free the ductus and applied two silk ligatures round it. The method of operating has not been changed greatly since then. Some, however, use cellophane around the ductus in order to provoke a reaction to aid the obliteration. Others have injected sclerosing fluids between the ligatures. After having examined the first forty patients some time after the operation GROSS found, however, that 20 % showed signs of recanalization, as the machinery murmur was still present. In half of these patients the sound was audible by the time the operation had been concluded, and it was assumed that the ligatures had not been drawn together sufficiently tightly during the operation. In the other half of the patients the sound became audible after a few weeks, and in these cases a recanalization of the ductus was supposed. GROSS has, therefore adopted a new technique, and now divides the ductus between clamps and sutures the vessels. It seems that more and more thoracic surgeons are adopting the method of division, whilst some work on individual indications using ligation if the ductus is long and division if it is short. Our own view on this matter will be given later.

Of the first 43 ligations performed by GROSS, there were three deaths. Since then he has performed 180 divisions with four deaths. In 1947 SHAPIRO recorded 626 cases of patent ductus arteriosus which had been operated on by 45 different surgeons. 431 ligations had been performed and of these 343 were uninfected and 88 infected cases. The mortality rate of the uninfected cases was 4.9 %, and of the infected 28.4 %. In the uninfected cases there were 30 recanalizations, *i. e.* 8.7 % and in the infected cases 4.5 %. In 195 cases of division of the ductus there were three deaths. In 182 uninfected cases there was only one death. It should, however, be noted that 172 of these 182 operations had

been performed by CROSS, CRAFOORD or WANGENSTEN, whilst the ligations had been performed by 45 different surgeons.

Material.

During the period from 1944 until July 1st 1948, 37 cases of patent ductus were operated at the Surgical Department A of the University Clinic (Rikshospitalet). Of these 30 were girls and 7 boys. There has always been recorded a preponderance of girls, usually in the ratio 2 to 1. In one case it is reported that the mother of the patient suffered from rubeola during pregnancy. This patient also had a congenital cataract. The other patients did not have any other malformation with the exception of one patient who had a deformed nose.

Age. This has varied between 4 and 32 years. Sixteen patients under 10 years, twelve patients between 10 and 20 years, and eight patients between 20 and 30 years, as well as one over 30 years.

Symptoms. In the case of 15 patients the anomaly was accidentally discovered, usually during the routine examination of school children or infants. 14 of these were under the age of 10. In five of these cases the mother, upon closer examination, could tell that she had observed that the child could not stand up to as much as other children, or had attacks of dyspnoea. Five of the adult patients stated that their anomaly had been diagnosed at the age of 2, 2, 3, 8 and 10, respectively. Only one of these had had symptoms for several years, whilst the others had only had symptoms for a few months before admission to hospital. It is striking how these patients have lived for years without their hearts giving any symptoms, until quite by chance, for example by participating in strenuous sports or going through a febrile illness, which has placed an extra strain on the heart, the first symptoms appear. The symptoms have otherwise been the usual: dyspnoea in 16 cases, increased lassitude in 14 cases, palpitations in 10 cases, precordial pains in 10 cases. In 7 cases the children were abnormally tired or irritable — one case of fainting. In two cases the patients were abnormally small and of infantile appearance. One has not, however, the impression that this is a common sign, particularly as far as the adult patients are concerned, as all of these, with one exception, were well developed. Upon

examination of the heart the typical machinery murmur was heard in 36 cases with maximum intensity at the second left interspace. In one case only the sound was not typical, and there was some slight doubt as to diagnosis before the operation. Palpable thrill was detected in 30 cases. In only two of the remaining cases it is particularly recorded that no thrill was palpable. The pulse pressure has on the whole been high. It varied between 30 and 40 mm Hg, on an average 70 mm Hg. It was below 40 mm Hg in 4 cases only. The high pulse pressure is to a considerable extent the result of reduced diastolic blood pressure. Several of the patients had relatively high systolic pressure, 9 patients had a systolic pressure of 150 mm Hg or higher. The patient, who was over 30 years of age, displayed signs of incompensation of the heart with enlarged liver etc. The other patients did not display signs of incompensation, notably none of them had had cyanosis. None of the patients showed signs of endocarditis.

The electrocardiogram was normal in 32 cases. The remaining cases displayed slight signs of disturbance of the myocardial function. By means of phonocardiography the typical continuous systolic and diastolic murmur was detected in all cases except one, in which the murmur was not quite typical.

Roentgen examination has given the following results.

Normal	1
Enlarged heart	27
Bulging pulmonary conus	27
Hilar dance	17
Pronounced lung markings	21

The first two patients were operated on by Dr. GADE who used Gross' original technique of an anterior incision. The others were all operated through the usual dorsolateral trans-thoracic incision with wide opening of the thorax. This incision has the great advantage of giving much better access and condition for operating, which is of considerable importance in the event of serious complications such as haemorrhage etc. Otherwise the operation was carried out in the usual way by opening the mediastinum between the vagus and phrenic nerves and dissecting free the ductus. Two to three ligatures were applied as far apart as possible. In the first cases linen ligatures were used. After having operated a case in which the ductus ruptured when the linen ligature was drawn tight, we changed to silk having the impression that silk

thread did not cut into the tissue to the same extent as linen. Sclerosing fluids were not injected between the ligatures. In all cases the thrill disappeared when the ligatures were drawn tight, which gave a guarantee of the sufficiency of the ligature.

Complications. There were no operative or postoperative deaths. In one case the thread cut through the ductus causing a profuse haemorrhage, but the bleeding was successfully controlled and the ductus was sutured on both sides of the lesion. Apart from this there were no particular complications during the operation, in particular neither cyanosis nor any other signs of cardiac failure have appeared in connection with the application of the ligature. The appearance of cyanosis usually indicates the presence of other cardio-vascular anomalies, which to a certain extent have been compensated by the ductus. Ligation of the ductus in such cases, therefore, only makes matters worse. It is, therefore recommended that, before applying the ligatures, one should perform a digital compression of the ductus and watch the patient during this procedure.

In most cases the postoperative reaction was moderate. A couple of the adult patients, however, were rather distressed for the first few days after the operation. Several patients were hyperpyretic during the first 4—5 postoperative days, the reason being obscure. One patient was hyperpyretic for three weeks, and the possibility of a complicating endocarditis was discussed. The blood culture, though, was negative. All the patients had a reactive effusion in varying degrees on the side of operation, and in 15 cases puncture was necessary. The exudate has never shown sign of being infected. Major atelectasis was seen in 5 cases. In young children one should always look out for atelectasis, as it is often difficult to make these patients cough adequately. Bronchopneumonia occurred twice. Signs of pericardiac affection were observed once. That was in one of the patients who was operated through an anterior incision when a lesion of the pericardium occurred during the operation. An unpleasant complication is paresis of the recurrent nerve. The recurrent nerve curls around the ductus arteriosus, and can easily be caught in the ligature near the aorta. Transient paresis can be the result if the nerve is stretched. There were two cases of paresis of the recurrent nerve, both of which were permanent. Haemoptysis has been recorded as a complication after operation for patent ductus arteriosus. JONES has reported two cases. He explains the haemoptysis as

being the result of the formation of an aorto-bronchial fistula after the operation. In one of his cases this was verified upon re-operation. Such complications have not been observed by us.

Control examination: 30 of the patients were re-examined some time after the operation (at least four months). 5 were re-examined by their local specialists. They were all fit and had no symptoms. None of them displayed any signs of recanalization. In two cases a slight systolic murmur could be detected, but no machinery murmur. The remainder of the patients were re-examined at the hospital. There was subjective improvement in all the patients who had had symptoms before operation. The majority were completely free of symptoms. Three of the patients though, were sometimes troubled by dyspnoea on exertion, but considerably less than before being operated. The patient who before operation displayed signs of incompensation was now able to go long walks without getting any dyspnoea, and the clinical examination revealed no signs of incompensation. Practically all the parents of the small children who were operated, related that the children had changed completely.

At the physical examination a systolic murmur could be heard in 4 cases, only in three cases this was verified by phonocardiography. Such a systolic murmur is no sign of recanalization. It is thought to be caused by a dilated pulmonary artery. Thus, the patient on whom a division of the ductus was performed, had a slight systolic murmur for a considerable period. Phonocardiography revealed in one case a systolic as well as a diastolic murmur but not the typical machinery murmur. This patient probably has a defect of the septum.

The pulse pressure is of particular interest. All the patients with one exception had a lower pulse pressure than before the operation. The exception had a normal pulse pressure before the operation (30 mm Hg). The decrease in pulse pressure is chiefly due to an increase in the diastolic blood pressure. Those patients, however, who before operation had a high systolic pressure, have after the operation got a lower systolic pressure. In no case was the systolic pressure above 150 mm Hg. The average pulse pressure after the operation was 40 mm Hg, as against 75 mm Hg before, i. v. a drop in pressure of 45 %.

Roentgenograms have in 15 cases revealed a definite decrease in the size of the heart. In all the remaining cases but one, a reversal of the pathological roentgenological signs have been

recorded, such as less prominent pulmonary conus, decreased pulsations etc. One case still has pronounced pulsations at the hilus, and there is no change in the size of the heart. This is the case in which we presume that there is a defect of the septum.

Thus we have 37 operated cases, 36 with ligature and one with division of the duetus, and no postoperative deaths. Control examination of 30 cases has not revealed any signs of reanalization. Under these conditions we regard double ligature as a safe method, and we will stick to it. However one looks at it, the method of division must be regarded as a bigger operation, even if surgeons like Gross have performed a great series of such operations with a lower mortality rate. It should be possible if these patients are operated during childhood — which in future should be done in all cases of patent ductus arteriosus — to apply the ligatures well apart. The difficulties of ligation are usually greatest in adults. The application of ligatures may, of course, in some cases be impossible, in which cases division is the only alternative.

The full value of these operations can probably not be estimated until forty to fifty years from now, but there is every reason to believe that the operation really prolongs the patient's lives.

Summary.

The author reports on 37 cases of patent duetus arteriosus as concerns symptoms, signs and roentgenological findings. All the patients have been operated on. In 36 cases a double ligature of the duetus has been performed, and in one case division. Sclerosing fluid has been not injected. There were no postoperative deaths. The complications have been as follows: Rupture of the duetus: one case, major atelectasis: 5 cases, paresis of the recurrent nerve: 2 cases. Control examination of 30 patients at least four months after the operation did not reveal any signs of reanalization.

The author concludes that the operation should be performed through a dorsolateral transthoracic incision. Generally, double ligature should be used, and the duetus should only be divided when ligation is not feasible.

Addendum.

Since submitting this paper a further 18 cases have been operated with one death (haemorrhage during the operation). A total of 55 cases have thus been operated at this hospital, with one death.

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From the Surgical Department of the State Hospital in Sønderborg.
(Chief Surgeon: P. WINDFELD.)

Some Experiences Concerning the Use of the Tetra-Ethyl-Ammonium in the Diagnosis and Treatment of Peripheral Vascular Diseases.

By
P. WINDFELD,
M. D.

In 1946 information came from America about a new drug, the Tetra-Ethyl-Ammonium, called Ethylon, which was able to block transmission of nerve-impulses through autonomic ganglia after intramuscular or intravenous injection. My attention was called to the new drug through a short message from the Orthopedic Hospital in Copenhagen in January 1948 after which I applied the drug at the surgical department of the State-Hospital of Sønderborg.

The information already existing in literature about the Ethylon is so interesting and the author's own observations so promising that the author should like to attract the attention to the drug, considering it a valuable supplement to the methods formerly employed by the diagnosis and treatment of peripheral vascular diseases.

It is a well known fact that operation on the autonomic nervous system in vascular diseases are directed towards the spastic element of the disease; by vasospasm the author understands an abnormous degree of vasoconstriction.

The question is now to discover whether we have to do with a mere vasospastic disease or an occlusive arterial disease or a combination of both. We know that by the thrombangitis obliterans as well as by the arteriosclerosis there is often a considerable vasospasm.

The methods applied all have the object to nullify the sympathetic tone within a certain vascular area.

This may be obtained in two ways: 1) By heating and 2) by blockade with procain.

If you raise the body-temperature of a healthy person, you will get dilatation, first of the vessels of the head, then of those of the hands and finally of those of the feet. By the Landis test, however, only a single extremity is heated up.

By blockade with procain the sympathetic vasomotor tone is temporarily abolished. As for the upper extremities this is done by injection of procain round the stellate ganglion, and with regard to the lower extremities by a blockade of the sympathetic trunk and of the rami communicantes, the so called paravertebral block. The drawback is due to the fact that by slow or incomplete rise of the skin-temperature of the extremity concerned one may be in doubt whether we have to do with an occlusive vascular disease or the blockade has been less successful from a technical point of view.

A surer method, however, will be the application of a spinal anesthesia by which one paralyzes the preganglionic fibres of the anterior roots. It must be remembered, however, that the preganglionic sympathetic neurons to the lower extremities are situated in the 11th dorsal to 2'd—5'th lumbar segments, and that consequently the anesthesia must reach a sufficiently high level in order to produce any action. If there is a pronounced rise in temperature, it is a certain sign that there is no obturating vascular disease. Unfortunately the drawback of the method is that it involves a great many inconveniences to the patient.

I do not want to enter into further particulars about the remaining clinical examinations necessary to make a differential diagnosis: measurement of the skin-temperature, oseillometry, pulsation of the vessels, degree of the filling of the veins, lividity of the extremities by elevation, Roentgenographie findings of the vessels, and so on.

The author only wants to remind of the fact that the temperature of the skin measured by intervals along an extremity may show a sudden great fall corresponding to the site of the arterial occlusion.

Fig. 1 shows the typical curves of the rise of the skin-temperature of the extremities in normal persons, by vasospasm and by obliteration after the Landis test or blockade by procain. (The

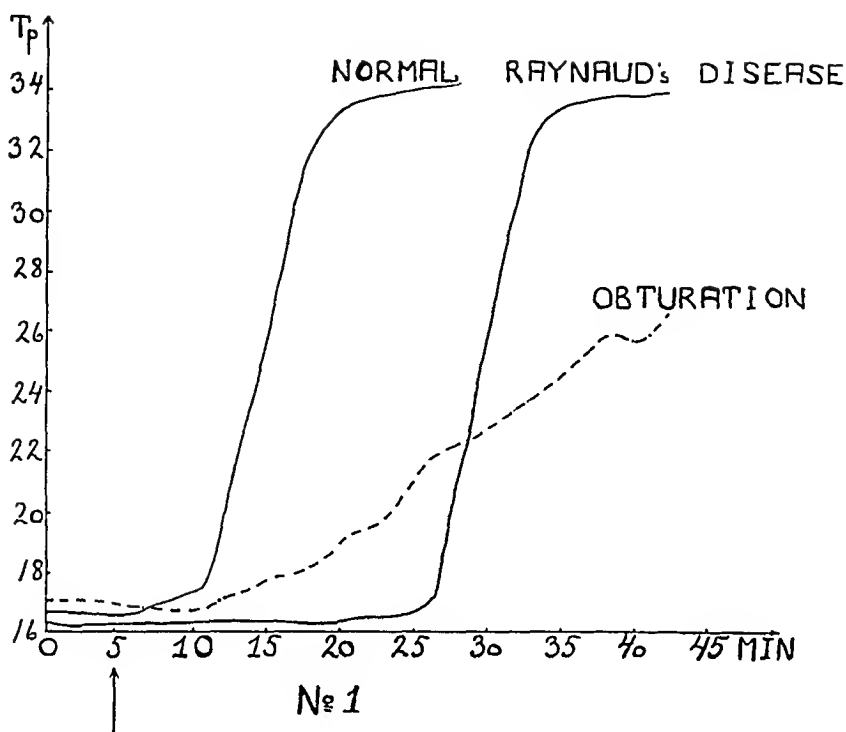


Fig. 1.

picture is from an article by TORSTEN LINDQVIST in "Nordisk Medicin".)

Besides the above mentioned diagnostic methods we have now by means of the Ethylon, Tetra-Ethyl-Ammonium, got a drug which injected intravenously or intramuscularly blocks the nerve impulses through ganglions. This action of the drug has been demonstrated on animals in 1945 by ACHESON and MOE at the Ann Arbor University. Their most important pharmacological and clinical observations after parenteral injection may very briefly be resumed as follows:

1) There is a fall in both the systolic and diastolic blood pressure and increase in the peripheral blood flow (by plethysmographic recordings).

2) The injection of T-E-A does not prevent the direct peripheral action of epinephrine.

3) Following the administration of T-E-A preganglionic stimulation produces no change in heart-rate, whereas the postganglionic stimulation produces a slowing of heart-rate, evidence that the site of action of the drug lies in the ganglion itself.

4) In man the same action is obtained on the blood circulation and blood supply to the extremities.

5) Further: Dilatation of the pupils (on account of blockade of the ciliary ganglion). Loss of accomodation, cessation of sweating, dry mouth, lowering of the gastro-intestinal motility.

6) Decrease in visceral pains.

7) No action of the T-E-A can be demonstrated in sympathectomized extremities whereas evidence of sympathetic block can be demonstrated in a normal control extremity in the same individual.

Investigations of the T-E-A for diagnostic and clinical use in man by peripheral vascular diseases were carried on by different collaborators at the Ann Arbor (BERRY, CAMPBELL, LYONS, MOE, SUTLER and COLLIER) and were published in Surgery in 1946.

Method of study employed: The patient was placed in a recumbent position, extremities uncovered in a room of suitable temperature. Thermocouple temperature recordings for control were taken from symmetrical points of the extremities. After that the T-E-A is injected intravenously in a 10 per cent solution ranging from 1—5 ccm. (100—500 milligram). *It must be injected slowly* at the rate of 15—60 seconds.

By the intramuscular injection — given to prolong the action — a dose was employed up to a maximum of 20 mgr. per kg. body-weight, but not more than 1.2 gram, half of it being injected into each gluteal area. The effect of intramuscular injection generally lasted 6—8 hours.

The Effect of Intravenous Injection.

After 15—20 seconds taste of metal (temporarily). After that a sense of coldness and death in fingers and toes, followed — in a time interval of minutes to hours — by a sense of heat and a considerable rise of temperature. As a rule increase of heart action and fall of blood-pressure, but in spite of that the cardiac output increases. The renal function is not affected. There is an almost quantitative and very rapid excretion of the T-E-A into the urine.

By *intravenous* injection there is an excretion of 50 per cent in the course of 1/2 an hour, and by *intramuscular* injection of 50 per cent in 3 hours. Almost everything has been excreted in 24 hours.

Toxic effects: In the communication from Ann Arbor in 1947 the drug was used more than 1,000 times on 500 patients with very few alarming symptoms. After intravenous injection the patient is left to rest for half an hour.

Caution is necessary in patients with great hypertension on account of fall of blood pressure, especially if at the same time there is a low renal function. Further in *elderly* patients and — according to our experiences — in diabetic arteriosclerotics.

Adrenalin promptly nullifies the collapse symptoms; at the same time the patient ought to be placed in a light Trendelenburg position.

In June 1947 further communications arrived from Ann Arbor by the same authors (in *Annals of Surgery*) about the effect of T-E-A on different diseases. Out of 20 cases of causalgia and posttraumatic dystrophy there was total or lasting cessation of pains in 10 cases and improvement in mobility. (Follow-up examination 2—6 months later.)

Number of blockades: 1—15 (doses in total 250 to 7,200 mgr.).

Buerger's Disease: In early and moderate cases pains and claudicatio disappeared in a great many instances and in some patients the effect lasted for 12 months.

In the cases where T-E-A produced rise of temperature, evidence of a present vasospasm, a subsequent sympathectomy gave a good result.

Cessation of pain in connection with injection of T-E-A comes very rapidly and may last, especially if the treatment is repeated, and is consequently not limited to the duration of the autonomic block. On the other hand the treatment with T-E-A has had no effect in cases of gangrene.

By peripheral arteriosclerosis obliterans T-E-A has proven useful in two respects: 1) aiding in the control of nocturnal pain, 2) as an index of the possible benefits that might be derived from a lumbar sympathectomy. Many cases of the arteriosclerosis show a pronounced vasospastic element, and in many cases the claudicatio decreases after the treatment with Ethylon. In established gangrene, however, the drug has been of no avail.

In acute thrombophlebitis an excellent effect has been obtained with cessation of pains and a quick regression of the edema.

As undesirable reactions the authors finally mention: Fall of blood pressure — dyspnea, in form of hyperventilation — fatigue developing into a mild degree of myasthenia. No serious complications.

Case Reports.

(Personal investigations.)

At the surgical department of our hospital we have used the Ethylon by the thrombngitis obliterans and dysbasia arterio-sclerotica.

Skin-temperature is measured by thermoelectrical apparatus. We started cautiously with 1 ccm. (100 mgr.) intravenously, but we soon discovered that to obtain an action a dose of 500 mgr. is often necessary. *Still, we continue to give 100 mgr. as a test dosage.*

The symptoms have been as described above. During the injection the patient gets a taste of metal and shortly afterwards parestesia in hands and feet. The sight sometimes becomes a little blurred on account of loss of accomodation. Not till 15—20 minutes after the intramuscular injection (often not till several hours after the intramuscular one) a pronounced sense of heat comes to hands and feet. The sense of heat has lasted up to two days and nights; spasms in the calves of the legs, the dysbasia, decreases considerably, and by means of walks in the garden of the hospital it has been possible for patients to state that they have been able to walk considerably farther than before the treatment. The fall of blood pressure is concomitant with the injection, but in patients with a normal or slightly elevated blood pressure we have seen no signs of collapse or on the whole of subjective inconveniences. Only in two elderly arteriosclerotics with diabetics we have had to give up the Ethylon injections, because of an attack of collapse which, however, rapidly disappeared by ephedrine injection. It should be kept in mind as a matter of importance that as a rule there is no vasospasm to be found in diabetic arteriosclerotics.

The author is now going to show curves from some of the patients to demonstrate the typical action.

The first patient is a man aged 66 with a marked dysbasia, almost of the same degree in both legs. Can only walk about a 100 meters at a stretch. Blood pressure 160/95. Roentgenograms of the legs do not show any sign of arteriosclerosis. Oscillometric records showed very small oscillations on the calf, better on the thigh. No pulsation in the dorsal artery of the foot.

A left lumbar sympathetic block (10 ccm. 1 % procain) gave no rise of temperature in the left leg.

A *right* lumbar sympathetic block as well as without any effect on temperature, but ten minutes after the injection the patient got a subjective sense of heat in the right leg.

The Ethylon, 100 mgr., is then given intravenously without rise of temperature or subjective sense of heat. 5 days later the Ethylon 500

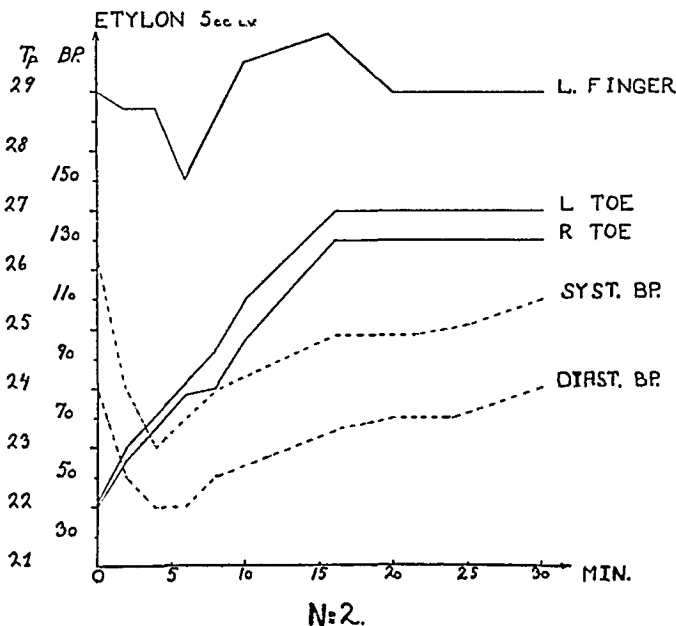


Fig. 2.

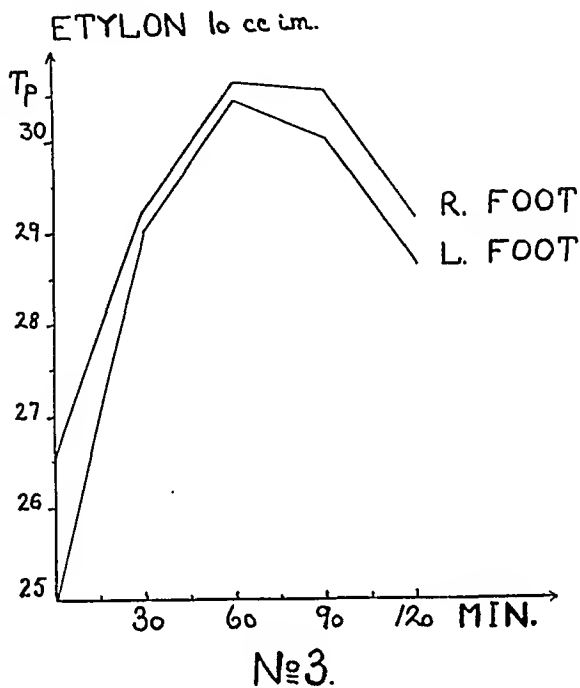
mgr. is given intravenously (fig. 2) and now we see a slow rise of about 5° on the lower extremities and get a curve typical of an obliterating disease with vasospasm.

The blood pressure drops during the first minutes from about 120 to about 60 but rises again quickly and spontaneously without subjective inconveniences.

The upper curve shows simultaneous changes of temperature on the upper extremities measured on a finger.

This is interesting by the fact that there is first a drop of temperature and not till then a rise of temperature as on the feet. The matter has been vividly discussed in American medical associations, especially at the annual meeting in 1947 of the American Surgical Association. Some scientists from the university of New Orleans (DE BAKEY, GEORGE BURCH, THORPE RAY and ALTON OCHSNER) have undertaken plethysmographic measurements + skin-temperature determinations in connection with paravertebral procain blockade by arteriosclerotic dysbasia. The result has been a significant increase in the volume and rise

of temperature on the sick foot and a simultaneous decrease of volume and temperature on the healthy foot and hand. From this they derive that the sick extremity borrows blood at the expense of the remainder of the body, considering the fall in temperature and volume of the healthy leg and arm a proof of



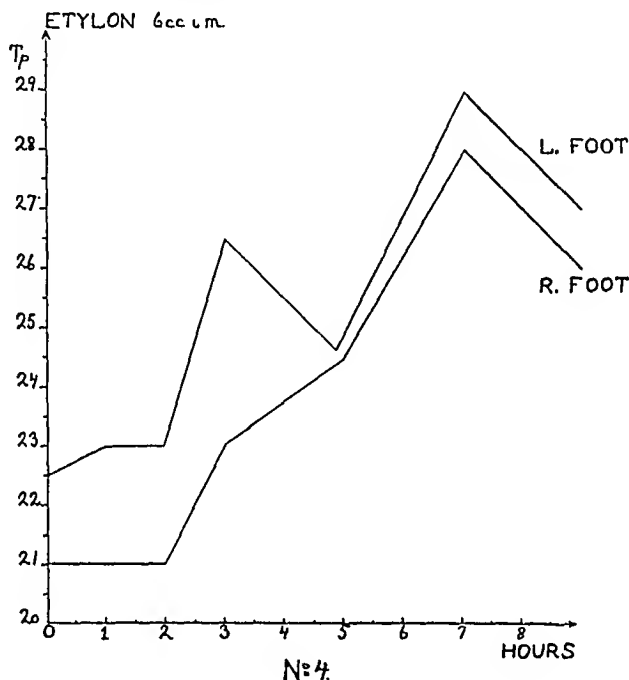
their observation. They term the phenomenon "borrowing-lending" hemodynamic mechanism, the blood being borrowed by the sick leg at the expense of the remainder of the body and is lent from the healthy arms and the healthy leg. Basing their opinion on this point of view they consider the Ethylon irrational, because the drug produces generalized vasodilatation, the effect of which might be dangerous and shock-like.

The New Orleans point of view is vividly countered to by the above mentioned Ann Arbor scientists who find just as great an increase of blood volume, plethysmographically, by intravenous Ethylon blockade as by paravertebral block, and a considerable increase of blood flow to the sick extremity. In spite of universal dilatation of the vessels this is due to an increased cardiac output which rises from 10—20 per cent after injection of Ethylon.

Fig. 3 is from the same patient who the following day got 10 ccm. intramuscularly. Again the rise of temperature attained is about 5°,

and a considerable subjective sense of heat was still remaining two days later at the patients dismissal from the hospital at which time he was able to walk round the hospital without the slightest pain in his legs.

The second patient is a man aged 52 with dysbasia arteriosclerotica of his left leg. Roentgenograms of the legs show moderate arterio-



sclerosis. Blood-pressure: Normal. Oscillometric records give no oscillations on left calf. Paravertebral block on left side: Only slight or doubtful rise of temperature.

Injection of Ethylon 100 mgr. intravenously produces no rise of temperature; nor is there any rise of temperature after 2 injections of 600 mgr. intramuscularly, but subjective sense of heat in left leg. Not till after the 3rd injection of 600 mgr. there is a considerable rise of temperature in left leg = right leg. (Fig. 4.) This effect lasted for two days and nights, after this the left leg became cold again, but at the readmission 6 weeks later there is still a considerable improvement of the dysbasia, as the patient is now able to walk 1 km. Then a lumbar sympathectomy is made with the removal of the 2nd and 3rd lumbar ganglion with good effect. The case clearly shows that even by means of Ethylon it may be difficult to nullify an existing vasospasm, and one ought not to give up even if there is no effect after the 1st and 2nd injection.

In a few patients the author did not succeed in getting a rise of temperature, though we obtained a subjective sense of heat

and an improvement of the dysbasia. Perhaps we have stopped too early with the Ethylon, yet SMITHWICK points out that there is a little group of patients where all attempts of blockade give a negative result, and where, in spite of that, the sympathectomy may have a surprisingly good effect.

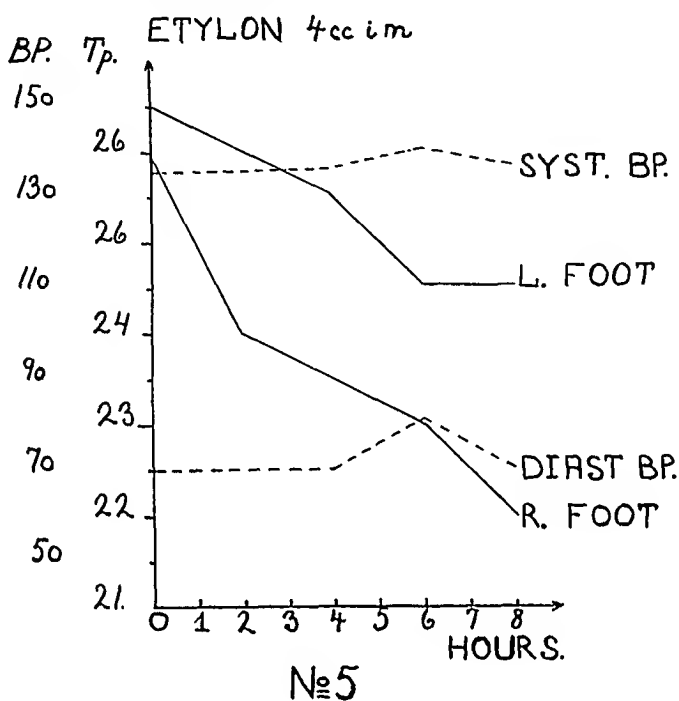


Fig. 5.

In one patient, a diabetic aged 75 with a beginning gangrene of the toes of the right foot, the Ethylon treatment had a quite different effect of the usual one, the right leg showing a considerable fall of temperature, while the fall of the left leg was not so marked. At the admission to the hospital oscillometry showed no oscillations on right calf, quite good on left calf. He first got a treatment with a magnesium sulphate injection of 50 % 5 ccm. intramuscularly — that was before we got the Ethylon — during which he was without pains, and the gangrene kept dry without any tendency to spread. Then we tried the Ethylon on him — 4 ccm. intramuscularly — and as the curve shows (fig. 5) there was a considerable fall in the temperature of the feet: the blood pressure was constant. At the same time there were great pains. The gangrene spread to the whole forefoot necessitating amputation on the thigh; the art. femoralis itself was almost quite obliterated.

It seems as if in this case the Ethylon has had a directly noxious effect in curtailing the flow of blood in the more distal parts of the extremity. In literature similar cases are referred in which

the lumbar sympathectomy has produced a rapid development of gangrene. Thus LAWRENCE ATLAS in the American Heart Journal of 1940 has communicated three cases concluding that an extensive arterial occlusion may be a contra-indication of lumbar sympathectomy. This is explained by ATLAS and other authors in the following way: The vasodilatation, produced in one extremity by blockade or sympathectomy, may by extensive arterial occlusion cause the greater part of the blood to remain in the proximal part of the extremity, by which the blood flow to the distal parts of the extremity was compromised. Possibly the arteriovenous anastomosis plays a part too. The arteriovenous communications are opened up after release of vasomotor tone by sympathectomy; by this the blood is shunted directly into the veins, and if the blood flow is already very much compromised in the peripheral part of the extremities this condition should be able to produce the gangrene.

It must be admitted that there are still many uncertain and unsolved problems in the treatment of peripheral vascular diseases. As SMITHWICK says, *it will be wise in order to avoid unpleasant surprises, by organic vascular diseases to demonstrate by some test before sympathectomy that there is also a vasospasm and that the circulation may be improved by release of this vasospasm.*

For this purpose the author thinks the Ethylon is a well suited means. Our experiences with T-E-A are still limited, so the author does not want to draw decisive conclusions from the few cases on which the author has had the occasion to try the drug. But the author has got the decisive impression that the T-E-A has given as a very valuable supplement to the methods formerly employed by the investigation of peripheral vascular diseases, because the drug with greater certainty produces an autonomic blockade. Basing the knowledge on the experiences already made by prominent American scientists with regard to the drug, the author thinks that the T-E-A blockade in many cases must be said to be able to bring the pains to a cessation by causalgia and posttraumatic painful states, and to diminish the dysbasia by the thrombangitis and arteriosclerosis, so that in a great many cases one may do without sympathectomy. If used reasonably and cautiously the Ethylon blockade is much less disagreeable to the patient than lumbar anesthesia. The author has not seen serious effects in connection with the Ethylon injections and in the literature which has been at the author's disposal no serious

case of collapse has been referred to, but one ought always to have ephedrine or adrenaline at hand.

Summary.

A short mention is made of a new drug Tetra-Ethyl-Ammonium called the Ethylon, which is able to block nerve impulses through autonomic ganglia.

Some case reports are referred where the Ethylon is used diagnostically and therapeutically. It is the author's impression that the T-E-A has given us a very valuable supplement to the methods formerly employed by the investigation of peripheral vascular diseases.

The Ethylon is also of importance therapeutically, as it is able to diminish the dysbasia by release of vasospasm and to reduce the pains by thrombangitis obliterans and arteriosclerosis.

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From the Finnish Red Cross Hospital.
(Chief: Professor A. SNELLMAN.)

On Thrombo-Embolia Diagnostics in Practice and on the Need of Anticoagulant Prophylaxis.

By

M. SULAMAA and AURA PENTTI.

The use of heparin and dicoumarin has not solved the problem of thrombo-embolia, but given us more effective means of dealing with complications following thrombo-embolia. A diagnosticated thrombus and often even an embolus can be successfully treated, the result being more favourable the earlier the stage at which the diagnosis has been determined. (J. E. JORPES, C. CRAFOORD, D. W. G. MURRAY and C. H. BEST, J. LEHMANN, G. BAUER, W. O. HELLSTEN, J. P. STRÖMBECK, S. BRUZELIUS, K. JANSEN, G. DE TAKATS and E. FOWLER, H. ZILLIACUS, M. SULAMAA.) It is now mainly only a question of getting as many patients as possible within the range of the effect of therapy sufficiently early, viz. a question of diagnostics. On the other hand, if this is not achieved often enough, a possible application of prophylactic treatment must be considered. The details of therapy, its effectiveness and simultaneously the degree of danger it involves for different patients are, as a general problem, of less importance. In the Finnish Red Cross Hospital "specific treatment", principally heparin, has been used since 1942, and cases of thrombo-embolia have been the subject of increased attention. On the basis of the material collected from 1942 to 1948, we have tried to solve the following questions:

1. Can the present clinical diagnostics be relied upon enough to allow us to depend entirely on specific therapy, or
2. Should prophylaxis be applied, to what extent and by what means?

In other words, we have tried to analyse the results of treatment of our material considering not only the diagnosed cases but also, as far as possible, undiagnosed cases or cases diagnosed too late, as well as the errors in diagnosis and treatment.

Material and Methods of Treatment.

In the Finnish Red Cross Hospital a total of about 22,000 patients was treated during the period 1942—1948. All cases of thrombo-embolia diagnosed *intra vitam* during this period have been included as well as cases which were strongly suspected to be cases of thrombo-embolia, and such fatal cases in which there was probably *intra vitam* unestablished thromboembolia. Only thrombosis of the deep veins of the legs and of the pelvis have been considered, and some cases of evident pulmonary embolism originating in a superficial thrombophlebitis, and some cases in which the site of the primary thrombosis could not be established. The diagnosed cases were mostly treated with heparin, 100 mg intravenously 3 or 4 times daily being the usual dose until the patient could get up when medication was gradually finished. Dicoumarin (in 48 cases) alone, or more frequently combined with heparin, was administered during the two last years. At the same time the prothrombin index was controlled and, as far as possible, kept between 30 and 60 per cent. Since 1946 a prophylactic "specific treatment" has been applied, although not regularly, in cases in which the danger of thrombo-embolia was considered imminent (38 cases). During the period from 1942 to 1946 "specific treatment" was commenced only when more or less manifest symptoms of thrombosis were present.

The majority of the material consists of acute cases, often traumatic surgical illnesses, a large group being composed of neurosurgical cases. The general state of health, particularly the condition of the circulatory system, was therefore good more often than usual, and the average age of the patients was lower than the average of the material generally obtained from surgical hospitals. About 10 per cent of the patients had been subject to operations on the abdominal cavity.

In the prophylactic treatment of thrombosis we have rather strictly followed the principle of early ambulation. The diagnosis was made on the basis of clinical symptoms, and cannot therefore be considered correct in all cases. Our efforts to confirm the

diagnosis roentgenologically had to be given up because of the limited supplies of contrast medium. The comparatively low frequency (0.8 per cent) of thrombo-embolia belies the assumption that cases erroneously diagnosed as thrombo-embolia may have been included in the material to any appreciable degree. The diagnosis of these cases in our material as thrombo-embolia must therefore be considered just as certain as in all large published clinical statistics.

Our material as a whole is as follows:

Total of treated cases.....	abt. 22,000
Cases of TE established intra vitam.....	156
Cases treated prophylactically on the basis of suspected unconfirmed TE (1946—1948)	38
Cases post mortem assumed to be TE.....	14

Diagnostics in the Light of the Mortality from Thrombo-Embolia.

Table 1.

The Mortality from Thrombo-Embolia.

Number of treated cases	Frequency of thrombo-embolia	Mortality from thrombo-embolia			Total
		undiagnosed	"specific treatment"		
			insufficient	sufficient	
22,000	(170) 0.8 per cent	(14) 0.06 per cent	(5) 0.025 per cent	(1) 0.005 per cent	(20) 0.1 per cent

The mortality from thrombo-embolia is mainly due to the cases that remained undiagnosed intra vitam. When the records of these cases are more closely examined it appears that the formation of the thrombus, as indicated by the symptoms, has not been speedier than usual and therefore so-called massive sudden embolism does not seem to be common in our material. Incomplete diagnoses were mostly due to incorrect interpretation of non-characteristic symptoms, to the concealment of symptoms by those of the original disease, and sometimes even to neglect.

Of the cases diagnosed 4 died so quickly, 1 to 2 days from the beginning of treatment, that there is every reason to consider the treatment insufficient. In one case of a bedridden patient heparin treatment, commenced in time, was interrupted before

the fever had disappeared completely. The result was a fatal sudden embolism one week later when the patient was allowed to get up. Only in one case in which heparin treatment, though of short duration, had been duly administered, was death considered due to thrombo-embolia although the possibility of death from heart failure cannot be quite excluded because of the incomplete case records.

The thrombo-embolia mortality of our material is low, 0.1 per cent, as compared to statistics published earlier (B. SINGER 0.65 per cent, H. BRAUN 0.17 per cent, E. RANZI and P. HUBER 0.25 per cent, G. BAUER 0.2 per cent, B. SULGER 0.27 per cent) and of the same rate as obtained during the time of "specific treatment", the principles of treatment being about the same (H. ZILLIACUS 1946 0.1 per cent). However, the death rate in our material does also include the undiagnosed cases which, with a fair amount of certainty, were post mortem believed to be thrombo-embolia. The mortality of our material is favourable inasmuch as only 3.8 per cent of the cases diagnosed intra vitam died of thrombo-embolia. The corresponding numbers in the material collected by H. ZILLIACUS are 20.4 per cent in surgical cases, 2.8 per cent in obstetric and gynecological cases, and 14.4 per cent in medical cases. Besides, no efforts have been made to include, in the material of H. ZILLIACUS, undiagnosed deaths from thrombo-embolia. Yet, the decrease in the death rate in our material achieved by "specific treatment" is so far nowhere near the maximum possible if the therapy by means of administered prophylaxis and considerably improved diagnostics could reach all cases of thrombo-embolia. The answer provided by the thrombo-embolia mortality to our first question about the reliability of the diagnostics is therefore definitely in the negative. The answer to our second question about the necessity of prophylaxis is in the affirmative.

Diagnostic Possibilities at Various Stages and in Various Forms of Thrombo-Embolia.

Diagnosis of cases which have reached the phlegmasia alba stage, is easy. It is, however, not advisable to wait that long since many patients die before this stage, and the prognosis of those surviving is impaired as a rule. This is also the case when embolism occurs as the first warning symptom. Further, diag-

nosing pulmonary embolism may prove very difficult since the most evident symptom, bloody sputum, is not constant in cases of small emboli. The diagnosis should be ascertained at an early stage when the subjective sensations of the patient and an increase of temperature are of the greatest importance as warning factors. An objective examination based on these indications then decides the diagnosis.

Table 2 shows the frequency of established symptoms in our material.

Table 2.

Warning symptom	Number of cases in per cent	Other simultaneous objective symptoms		
		Increase of temperature in per cent	Tenderness or pain on stretching in per cent	Swelling or cyanosis in per cent
Increase of temperature	(33) 19.4	—	(25/33) 75.8	(11/33) 33.3
Subjective sensations	(106) 62.4	(45/106) 42.5	(99/106) 93.4	(58/106) 54.7
Symptoms of pulmonary embolism	(17) 10.0	(8/17) 47.1	(5/17) 29.4	(3/17) 17.6
Undiagnosed deaths	(14) 8.2	—	—	—
Total	(170) 100	(86/170) 50.6	(129/170) 75.9	(72/170) 42.4

The question of the warning symptom is with regard to the problem as a whole, of the greatest importance. In as many as 8.2 per cent of the cases no warning occurred. Irrespectively of whether this fact is due to neglect by the patients themselves, or by the personnel, to indolence, or to lack of competence, the number of patients left without "specific treatment" is too great. Further, where symptoms of embolism have acted as warning factors in 10 per cent of the cases, the value of early symptoms as warnings must be considered insufficient. To rely entirely on a diagnosis based on early symptoms does not therefore seem justified.

From the table there also appears the fact that no symptom is constant or clearly pathognomonic in its early stages. Even an objective examination performed after the occurrence of some warning symptom does not therefore always exclude a diagnosis of thrombosis. Efforts have been made to confirm the diagnosis

by means of various methods of phlebography, but, on one hand, these methods are too difficult to be used as a rule and, on the other hand, the conclusiveness of phlebography has been called in question by several authors (*i. a.* K. LINDBLOM, M. SULAMAA).

The inconstancy of the direct symptoms of thrombo-embolia in our material indicates that a reliable early diagnosis cannot by a long way be ascertained in all cases. Prophylactic therapy must therefore be considered justified and indicated.

The Importance of the Original Disease and Other Etiological Factors for Thrombo-Embolia Diagnostics and for the Administration of Prophylaxis.

Factors predisposing to thrombosis may be of great importance in indirect diagnostics, in addition to the few non-characteristic symptoms, as indications for prophylactic treatment. By classifying our material according to the original disease we show the variations in the frequency of thrombo-embolia in the various groups.

Table 3.

Group	per cent of all treated cases	Number of cases of TE	per cent of cases of TE	Frequency of TE in per cent	Time of onset in days
1. Diseases of the abdominal cavity and the pelvis ¹	abt. 9	49	28.8	2.5	12.1
2. Diseases of the blood vessels	abt. 8	14	8.2	0.8	7.3
3. Treated primarily for TE	—	30	17.7	—	—
4. Infectious or septic diseases	abt. 8	17	10	1.0	14.1
5. Other treated diseases	abt. 75	60	35.3	0.4	26.0
Total	100	170	100		

¹ with the exception of cases of uncomplicated herniae and appendicitis.

The high frequency of thrombo-embolia in cases of diseases located in the abdominal cavity and the pelvis appears clearly from our table (group 1). The time of onset of the disease as counted from the day the patient was laid up in bed, or from the

day of operation is in this group considerably shorter than the average. In the group of diseases of the blood vessels (group 2) the majority of the cases occurred as a result of varicose constitution. The frequency is higher than the average and the period of "incubation" is remarkably short, evidently partly due to the means of treatment. Cases treated primarily for thrombo-embolia (group 3) are comparatively numerous. Also in most of these patients some predisposing original disease was found that alone did not bring the patient for hospital treatment. The thrombo-embolia frequency in septic or infectious diseases (group 4) is 1 per cent, thus higher than the average. The last column (group 5) comprises the majority of the cases, viz. cases treated for "other diseases". Patients of this group have no immediate predisposition towards thrombosis because of their original disease, as is the case with the patients of the other groups. In these the predisposition in the various cases depends on the age, on the condition of the circulatory organs, or on the duration of the immobilization more than in the former groups.

The predisposing influence of age seems evident since 2/3 of our cases of thrombo-embolia were more than 40 years old, whereas patients of 40 years or more did not even form one half of the material that was used as a control. In the statistics of SARAFOFF and R. GEISSENDÖRFER the frequency of thrombo-embolia evidently rose with increasing age. The predisposing influence of age must, however, be partly illusory since other predisposing factors probably increase simultaneously with increasing age.

Diseases of the circulatory organs that can be established even by a cursory examination (accessory heart sounds, hypertonia, large varices etc.) are evidently more frequent (30 per cent) in cases of thrombo-embolia than in other patients counted for the sake of comparison (15 per cent). Diseases of the heart and blood vessels were established at autopsy in 57—70 per cent of the cases of thrombo-embolia (FAHR, F. KUHN).

Confinement to bed of long duration evidently seems to predispose to thrombo-embolic complications. Of patients suffering from thrombo-embolia 40 per cent of group 5 had been confined to bed more than 14 days before the onset of symptoms, the corresponding percentage being 11 for the controls. The later average time of onset (26 days) of the "other treated thrombo-embolic cases" also supports the suggestion that the thrombo-embolic predisposition increases with a long confinement to bed.

In 29 per cent of the cases of thrombo-embolia in our material there are general or local infections, corresponding to 19 per cent in others. H. LUBARSCH and H. v. SEEMEN particularly stressed the predisposing influence of infections on the occurrence of thrombo-embolic complications.

It has been asserted that the injection therapy that has been increasingly used during the last decades has added to the thrombo-embolic frequency (FAHR). In our material the percentage of patients who received blood, plasma, or other infusions is not greater in cases of thrombo-embolia than in the whole material.

Of the 14 cases that died of thrombo-embolia undiagnosed intra vitam some operation of the abdominal cavity had been performed on 9, the records of 10 included notes on affections of the heart or of other circulatory organs, in 3 cases there were wound or other infections, 8 were more than 60 years old, and 7 were laid up in bed more than 2 weeks owing to illness. There was thus a multitude of predisposing factors, and prophylactic treatment administered on this basis could have lowered the thrombo-embolia mortality considerably.

Ascertaining the influence of etiological factors justifies certain conclusions. Patients with a predisposition to thrombosis may be considered exposed to greater danger the more numerous and the more powerful the factors that act simultaneously. The indications for prophylactic therapy should then be considered stronger than usual when, for instance, a predisposed patient has to be confined to bed if only for one week, and prophylactic therapy should be instituted even though no warning symptoms be present. The frequency of thrombo-embolia would probably decrease considerably in this way, and undiagnosed latent cases of thrombosis would be treated. Whether it is easier to administer proper prophylaxis than to apply prophylactic therapy, to patients exposed to the danger of thrombosis only when the confinement to bed is prolonged, or on the occurrence of even slightly suspect symptoms cannot be determined on the basis of our material. J. P. STRÖMBECK (1947) recommended the former and C. CRAFOORD the latter method.

Discussion of the Results of Treatment in Our Material.

Table 4 shows the results of treatment on the material separately for the periods of 1942—1946 and 1946—1948, prophylaxis

Table 4.

Total Results of Treatment (1942—1948).

Number of cases	Frequency of TE in per cent	The mortality of TE in per cent of the cases				
		Un-diagnosed	Specific treatment		Mortality of TE in total per cent	
			insufficient	sufficient		
1942—46 13,000	(77) 0.6	(10) 0.08	(2) 0.015	(0) —	0.1	
1946—48 9,000	(93) 1.0	(4) 0.04	(3) 0.03	(1) 0.01	0.1	
Total 22,000	(170) 0.8	(14) 0.06	(5) 0.025	(1) 0.005	0.1	

being used to some extent during the latter period. The mortality from thrombo-embolia is the same for both periods, viz. 0.1 per cent. In spite of the greater frequency during the latter period the percentage of deaths of undiagnosed thrombo-embolia is not as great as during the former. The occasional application of prophylaxis and the trifling differences do not justify further conclusions. On the other hand there are a remarkable number of cases of thrombo-embolia which received insufficient or no "specific treatment", a total of 19 cases of which 5 were diagnosed too late, or were otherwise insufficiently treated. This is an indisputable proof of the imperfection of diagnostics and of the necessity of prophylaxis.

Table 5.

Results of the "Specific Treatment".

Number of cases	Deaths			Completely satisfactory result		
	From the original disease	Insufficient treatment	Sufficient treatment	Diagnosed at an early stage	Diagnosed at the embolic stage	Diagnosed at the phlegmasia alba stage
156.....	6	5	1	92 %	65 %	50 %

Of the cases which received "specific treatment" one died in spite of a treatment that was considered sufficient, the cause of death being, however, uncertain; it was either heart failure or embolism. In four cases the treatment was delayed owing to the diagnosis, and one died because of an error in the therapy, the heparin treatment of a bed patient being terminated owing to a misunderstanding, one week earlier. The judging of the results

of the specific treatment is rendered more difficult from a scientific point of view by the uncertain diagnostics. The advantage of a treatment that has been commenced at an early stage appears, however, clearly both from our material and from results reported by others. On the other hand, bearing the general effect of combatting thrombo-embolia in mind, treatment of uncertain cases is indicated since the prognosis both as regards the mortality and the invalidism grows worse as time goes on. No comparison of our results of treatment with those of other authors can be made directly on the basis of numbers. Our results seem, however, to be comparatively favourable considering that undiagnosed cases were included which post mortem were believed to be cases of thrombo-embolia.

Although our results are apparently good they can by no means be considered the best possible until cases that have not been diagnosed at an early stage, can be brought within the range of therapy by means of prophylaxis. A maximally favourable thrombo-embolia defence demands skilful nursing not only in the treatment of manifest cases of thrombo-embolia but also in the promptitude to apply prophylactic therapy. The knowledge of factors favouring the occurrence of thrombo-embolia is then of assistance when cases that need prophylaxis are chosen. The first and most necessary condition for a successful defence against thrombo-embolic complications is *early ambulation*, another is *administration of anticoagulant prophylaxis in cases when early ambulation is impossible*, or when the patient owing to his disease or to his constitution has a greater predisposition towards thrombosis than the average, and a third *a serious effort to arrive at an early diagnosis and early treatment*.

Summary.

The authors posed for themselves the following questions: 1) is clinical thrombo-embolia diagnostics effective enough, or 2) should prophylactic therapy be applied and to what extent?

In the Finnish Red Cross Hospital the material during the period of 1942—1948 showed, although the principle of early ambulation had been followed, a thrombo-embolic frequency of 0.8 per cent (170 cases) of which 0.06 per cent (14 cases) died undiagnosed intra vitam, the total mortality due to thrombo-embolia being 0.1 per cent. In the diagnosed cases of thrombo-embolia

which led to death, specific treatment had mostly been commenced at too late a stage of the disease. The diagnosis thus remained unsettled in at least 8.2 per cent of the cases of thrombo-embolia. In addition thrombo-embolia was established too late in a considerable number of cases, viz. not until the stage of embolism, or of phlegmasia alba. At an early stage the symptoms were so inconstant and non-characteristic that the authors tried to determine the indications for a prophylactic therapy on the basis of etiological predisposing factors. Diseases of the blood vessels, affections of the cardiac valves, varices, cachexia and obesity, infections, old age and prolongation of a necessary confinement to bed are factors which increase the predisposition and which can be established in practice. In diseases of the abdominal cavity and of the pelvis the frequency of thrombo-embolia (2.5 per cent) was vastly higher as compared with the average, and at the same time complications occurred earlier (after 12 days) than on the average in other patients (26 days).

The authors consider an application of specific prophylaxis as possible in those small groups of cases that are considered predisposed to thrombo-embolia, and they are of the opinion that prophylactic therapy should be applied immediately on the occurrence of even the slightest suspect symptoms.

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On the Course of Healing of Subcutaneous Renal Rupture and So-called Traumatic Nephritis.

By

PER-HUGO EKDAHL and YNGVE OLSSON.

Reports in the literature on the sequels of subcutaneous renal rupture are rather scarce. Especially the so-called traumatic nephritis, which occurs fairly often, has been discussed of late by very few authors.

There is general agreement that there are focal lesions of the renal parenchyma without specific localization to the glomerular or to the tubular apparatus. It has further been established that this "nephritis", which in the urine is reflected in the form of albumin and white cells and occasionally with granular casts, disappears when the lesion of the kidney heals clinically (inter alia KOCH 1931).

Two cases, treated at the surgical department of Kristianstad Hospital, have given the authors occasion to present a short outline of the subcutaneous renal rupture and the "traumatic nephritis". This has in both of the present cases been shown to heal parallel to the healing of the renal injury, as established by roentgen examination. The cases are those of two children who, after mild trauma, were both admitted with signs of subcutaneous renal rupture.

Case I: 2184/47. An 8-year-old boy was admitted on the evening of August 7, 1947. Two hours previously he had fallen on his right flank to the ground from a height of one meter. *Status* on admission: relatively uninfluenced general condition but complained of pain in the right flank. No sign of fracture of the ribs or of other fractures. Abdomen: Soft with absence of defence. Slight tenderness in the right flank. Urine: Macroscopically bloody. Pulse 94, well filled. Control of the

pulse and observation during the night revealed nothing disquieting. *Aug. 8: Roentgen examination* (scout film of the abdomen): the right psoas outline is not visualized, the left is very distinct. There is a slight scoliosis, convex to the left. *There is probably a perirenal blood infiltration to the right (fig. 1).* — There was very bloody urine with coagula for the first two days. On the third day there was pronounced tenderness and defence to the right in the meteoristic abdomen. A few days later there was a pronounced improvement; the urine was bloody microscopically only. Abdomen: no resistance was palpated in the right renal fossa. The temperature was about 38° C for the first 3 days and then became normal. The pulse throughout was normal and well filled. Output of urine (per twenty-four hours): The first two days, 200 to 300 ml; the following week, approximately 600 ml; and after this, normal amounts. *Aug. 8:* Hb. 75 %; red cells 3,750,000; S. R. 25 mm/1 hr., non-protein nitrogen 35. *Aug. 9:* Hb. 65 %; red cells 3,400,000; non-protein nitrogen 38. *Aug. 15:* Hb. 66 %; red cells 3,550,000. *Aug. 23:* Hb. 70 %; red cells 3,400,000; S. R. 13 mm/1 hr.; non-protein nitrogen 26. *Aug. 26: Roentgen examination* (intravenous urography): In the right kidney there is a rupture of the renal parenchyma and of the renal pelvis. The renal pelvis is broken into an upper and an under fragment. The contrast medium in the middle and upper portions of the kidney flows into a large cavity, which laterally penetrates to the renal capsule (*fig. 2*). *Sept. 1:* Urine: Heller +; white cells 7—10/per microscopic field; for the rest, nothing pathological. The patient was discharged.

Sept. 16: Roentgen examination (intravenous urography): The cavity of the wound has contracted and is considerably smaller than earlier. There is normal excretion from the upper and lower calices. The outline of the kidney is now visualized as well as the psoas outline (*fig. 3*).

Sept. 20: Urine: Heller positive; white cells: abundant; 0 red cells; 0 casts; 0 bacteria. *Oct. 7:* Urine: Heller, traces; white cells, moderate; for the rest, nothing remarkable. Hb. 80 %; red cells: 4,500,000.

Nov. 17: Roentgen examination (intravenous urography): Not much evidence of the wound is observed now. The outlines of the renal pelvis in the middle portion of the kidney appear more distinctly, but all of the calices are not yet normal (*fig. 4*). *Nov. 17:* Urine: Heller, traces; white cells, 8—10 per field. For the rest, nothing remarkable.

Jan. 27, 1948: Urine: Heller, negative; white cells 1—2/field; for the rest, nothing remarkable. *Feb. 27, 1948:* Urine: Heller, negative. Sediment 0 pathological.

Case II: 2535/47. A girl aged 11 was admitted on July 26 to a hospital elsewhere. Abstract from the records of that hospital: July 26 the patient in the afternoon fell from a swing one meter to the ground. She immediately became pale and influenced and complained after 30 minutes of intensive pain in the right abdomen. The general condition became increasingly deteriorated and the abdominal pain more and more severe. Rupture of the liver was suspected, but as the patient immediately on admission voided bloody urine, the diagnosis of renal

rupture was more probable. The pulse was soft and rather rapid. Abdomen: quite intense tenderness in the right abdomen, most pronounced over the right lumbar region. July 28 the urine was macroscopically clear.

The patient was referred to Kristianstad Hospital *Sept. 6*. Status on admission: general condition not remarkable. Abdomen: soft and non-tender, nothing pathological palpable. No tenderness over the renal fossae. *Sept. 6*: Urine: Heller, positive; white cells, abundant; 0 red cells; occasional casts; 0 bacteria. *Sept. 9*: *Roentgen examination* (scout film): a thin calcification shadow was visualized on the site of the right lower pole (*fig. 5*).

Sept. 9: *Roentgen examination* (intravenous urography): The upper and middle portions of the right renal pelvis normal. In and around the lower kidney pole there is a more or less connected calcification which reaches far up on the lateral side. It obscures the lower calices. It is apparently a large calcareous hematoma (*fig. 6*).

The patient was discharged *Sept. 10* with Hb: 71 %, red cells: 3,400,000. S. R. 35 mm/hour. Non-protein nitrogen: 27.

Oct. 2: Urine: Heller, traces; white cells, 20—30 per field; 0 red cells, 0 casts, 0 bacteria. S. R.: 18 mm/hour.

Oct. 30: Urine: Heller, traces; white cells, 10—15 per field; for the rest 0. Hb: 77 %, red cells: 4,450,000.

Nov. 18: *Roentgen examination* (intravenous urography): The calcification has decreased appreciably, and the outlines of the lower calices can now be distinguished. There is a rupture of a calix with a wound cavity in the lateral portion of the lower kidney pole. The wound is rather small and does not penetrate to the renal capsule (*fig. 7*).

Nov. 18: Urine: Heller, negative; white cells, 5—10 per field; for the rest 0.

Dec. 18: Urine: Heller, negative; white cells, 5—10 per field; for the rest 0.

Jan. 22, 1948: Urine: Heller, negative; white cells, occasional; for the rest 0.

The patients were thus controlled with urinalysis about every 2 weeks and roentgenological examination (intravenous urography) once a month, or every other month. It appears from the case histories that there is parallelism between the improvement of the urine findings and the healing demonstrated through roentgen examination. Cystoscopy and clearance examinations were unfortunately not carried out. The patients did not have nephrotic quantities of albumin in the urine; there was no edema, and the blood pressure was normal. The pulse was smooth and regular, and there was no cardiac enlargement demonstrable at percussion; there was no increase of non-protein nitrogen. Because of these specific conditions the terms nephritis and nephrosis should perhaps not be used in this connection.

It is stated in the literature, that the subcutaneous renal ruptures mainly are sustained by adult males. In the cases described above, however, we have to deal with children and an outstanding feature in both cases is the mild trauma, which caused the rupture. There are cases reported, however, in which, *e. g.*, the lifting of a heavy object, a sudden stretching of the back or a jolt while riding have occasioned a rupture. It is more natural that a direct blunt trauma against the renal region, such as the kick of a horse, or a crush-injury, may cause a rupture. There are various explanations as to why the kidney ruptures at indirect trauma. KÜSTER's explanation that a sudden increase of the intraabdominal pressure should give an "explosive effect" on a bloodfilled, normal kidney has largely been abandoned, since KROGIUS experimentally showed that in renal ruptures there should be differentiation between expansion and compression ruptures. The expansion ruptures are at right angles with the direction of the trauma, are superficial, and generally have sharp margins. The compression ruptures follow the direction of the trauma, are generally deeper and have torn margins. These experiments were substantiated pyelographically by FRITZ (1928).

Classification of renal ruptures according to their degree of severity has been endeavoured (*cf. inter alia* PUHL; COLSTON and BAKER (1937)). The latter authors have investigated the sequels of renal rupture and have thereby adopted the following schematic illustration of these ruptures from Osgood and Campbell.

- A. Rupture of the fibrous capsule with ruptures into the parenchyma. Insignificant extravasation.
- B. Multiple, complete ruptures with potentiality also of perirenal extravasation.
- C. Rupture of the fibrous capsule with rupture of the cortex penetrating *to* the renal pelvis. The hemorrhage here soon ceases owing to the perirenal compression.
- D. Rupture of the fibrous capsule + parenchymal rupture *into* pelvis. A relatively large perirenal extravasation and lesion of the pelvis.
- E. Rupture of the parenchyma *into* the pelvis without rupture of the capsule.
- F. Mildest. Parenchymal rupture without rupture of capsule.
- G. Total separation of the renal hilus. Life-threatening.
- H. Separation of the ureter.

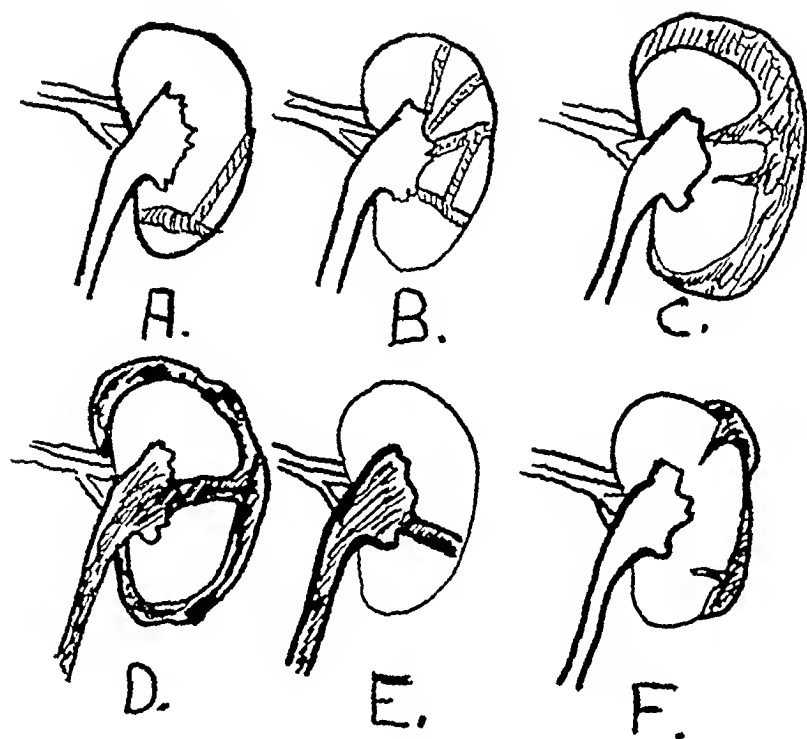


Fig. 8.

In the present cases the rupture of the male patient must be considered to belong to type D, and the rupture of the female patient, to type C + a small rupture of the calix.

The symptoms of the subcutaneous renal rupture are well known, wherefore a further description will not be entered upon in the present paper.

The intravenous urography and the retrograde pyelography are obviously of value for the diagnosis. It should, however, be borne in mind that the intravenous urography is of little value when the patient is in a condition of shock, as pointed out by *inter alia* LJUNGGREN (1936) and CANNON (1946). In a condition of shock one is reduced to scout films, which sometimes, as in case I, may afford information on perirenal infiltration of fluid, which may be helpful if the remainder of the symptoms is vague. Retrograde pyelography may obviously carry some risk, as it may introduce an infection. The fear of this, however, must be considered greatly exaggerated, as stressed by BOEMINGHAUS (1943), LJUNGGREN (1936) and others. This latter author is of the opinion that intravenous urography should be carried out as soon as the patient has recovered from the shock, as this examination eventually may

exclude a renal rupture. Furthermore, urography gives valuable information relevant to the function of the eventually injured kidney and also, which is of great importance, there is obtained a clear impression of the secretory capacity of the uninjured kidney. If there, after repeated intravenous urographies, is not observed any secretion on the injured side, one should, according to Ljunggren, resort to retrograde pyelography as a valuable complement, and the therapeutic management of the case should be planned accordingly. As appears from, *inter alia*, the present study, intravenous urography affords excellent opportunities of following the healing of the renal lesion.

As soon as the urinary secretion is functioning one can easily form an opinion of the extent of the injury and to what extent it is complicated by renal pelvis- and capsule perforation(s). If there is no secretion at all after some lapse of time, the conclusion drawn obviously is that a grave parenchymal lesion is present. COE (1936) considered this impairment of function due to coagula in the renal pelvis, this condition giving rise to such a heavy retrograde pressure, that the secretion is suspended.

At examination a week or so after the trauma there may be revealed a greater or lesser wound cavity, filled with contrast medium; the contrast fluid forms an irregular depot, commonly largest at the border between the parenchyma and the pelvis. From this cavity are filled fissures which at times obtain to the renal capsule. At rupture of the capsule, the contrast fluid flows out to the surroundings of the kidney, hereby constituting a more or less connective "shell". The wound cavity gradually decreases in size. The margins become smoother and more distinct. The calices in the periphery of the rupture are regenerated.

In a later stage are observed signs of shrinking of the scar, partly general and partly local. Segments of the fractured renal pelvis approach each other. In calyx ruptures deformations and changes of size commonly ensue.

Opinions are divided as to whether the management should be conservative or radical. It appears, however, from reports in the literature, that one may follow a conservative treatment even in quite extensive ruptures. This question, to a certain extent, falls beyond the scope of the present paper, wherefore the reader is referred to the studies of PUHL, BOEMINGHAUS, LJUNGGREN, COLSTON and BAKER, SMITH, STIRLING and others. Among the surgical sequels to the subcutaneous renal ruptures should be mentioned:

calcified blood cysts with reduced renal function following rupture of type C, and cicatricial healing of pelvis with hydronephrosis as a sequel to ruptures of types D, E and H (COLSTON and BAKER 1937). HANSEN found posttraumatic hydronephrosis in 10 per cent of the cases in his series. In the literature there are furthermore described a number of cases with "posttraumatic renal calculi". The "nucleus" of the calculus is considered to be a coagulum, this has been demonstrated, inter alia, by DUBNER (1931), HANSEN (1934) and COLSTON and BAKER (1937).

A specific sequel, which in regard to the prognosis is not of the same importance as those mentioned above, is the post-traumatic nephritis or nephrosis, as it also has been termed (KIRSCHNER-NORDMANN 1925). Already in 1840 RAYER described a "Néphrite traumatique" without, however, differentiating between this and other nephritides. Subsequently, around 1900 there followed several reports by STERN and others. STERN described the concept as "patients, who up to one year after the lesion have albumin, white and red cells and occasional granular casts in the urine, without showing other signs of nephritis". Stern therefore considered that the condition should be regarded as a focal aseptic interstitial nephritis. CURSCHMANN in 1902 presented a survey of this particular problem, in which he also used the term: interstitial nephritis. A detailed study was published by KOCH 1931, in which he, inter alia, established that the renal lesion is unilateral, that the albuminuria and the hematuria are transient, disappearing in connection with the healing of the lesion. KOCH further reported that it has never been proved that an acute diffuse glomerulonephritis has occurred in connection with trauma. In agreement with the animal experiments of KÜSTER (1896) and ORTH (1905), among others, it has been seen that an injury of the kidney leads to *focal changes* that become necrotic and heal with interstitial scarification, to which are contributory, inter alia, the white cells and the secretion of albumin (as in common wound healing). No histological proofs whatsoever were found for general diffuse acute glomerulonephritis, nor has any rise of blood pressure, as seen in glomerulonephritis, been established. CORRY (1946) published 5 cases of subcutaneous rupture of the kidney in which he established an early rise of blood pressure, lasting only a couple of days. He considers this of importance only in that he, by the rise of blood pressure, believes it feasible to exclude other visceral ruptures, such as, by way of example, rupture of the spleen; he does not,



Fig. 1.



Fig. 2.

EKDAHL and OLSSON: Healing of Subcutaneous Renal Rupture.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.

EKDAHL and OLSSON: Healing of Subcutaneous Renal Rupture.

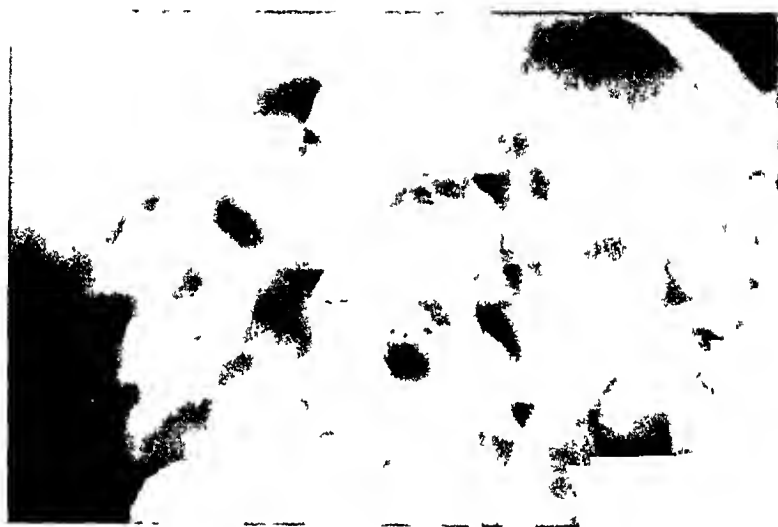


Fig. 7.

however, offer a definite explanation of the cause of the rise of blood pressure.

The at least microscopic hematuria, which in most cases accompanies the renal ruptures, is unilateral, which was established by cystoscopy by KOCH (1931), among others. Neither have any true nephritic edemas been demonstrated. Most of the cases hospitalized with edema have rather showed the picture of a "nephrosis", in which there, in no instance has been question of primary renal lesions, but of more complicated injuries, especially fractures of the long bones, injuries of the spine and of the cord, extensive contusions, widespread burns, "crush-injury". In these conditions there has been established a more or less grave destruction of the kidney tubules, with rather large quantities of albumin, myoglobinuria, hemoglobinuria, red and white cells and granular casts in the sediment. This typical picture has, by VOLHARD, inter alia, been considered due to an auto-intoxication owing to decomposed native albumin. In these cases the kidneys show a histological picture identical with that described inter alia by MALLORY in 1947. This author terms the condition "lower nephron nephrosis", which implies that the tubules as well as the stroma of the kidney are the site of degenerative changes, while the glomeruli always are intact. MALLORY states the cause to be a combined action of the precipitation of pigment, allergic factors, ischemia and eventually auto-intoxication due to the destruction of albumin. The primary anuria or oliguria often established at renal ruptures may be due to the shock, even although a purely reflex traumatic hematuria may be the cause.

HANSEN (1934) published a series of 45 surviving patients with ruptures of the kidney. Among these he found 5 cases of traumatic nephritis, which began on the third to the tenth day after the trauma but which disappeared after two to three weeks. He believed the condition to be due to a "toxicosis" caused by the destruction of tissue in the injured kidney. The recent cases have actually shown changes in the urine over a considerably longer period and these changes have decreased gradually as the healing process has progressed. The question as to whether this albuminuria and abundance of white cells in the urine is an expression of a "toxicosis" or a sign of healing of the renal lesion must probably remain unanswered for the present. KOCH, among others, has discussed the possibility of a picture of glomerulonephritis, appearing after a very long interval, but has not found any def-

inite proofs for this. BERETERVIDE (1929) described a case which gave rise to a "unilateral" nephro-sclerosis picture (established by ureteral catheterization). — HANSEN, in his large series, after an adequately protracted period of observation found more or less grave pyelonephritic changes in all of the cases, but does not consider these changes to have any direct association with the traumatic nephritis. FISHBERG, in his extensive monography quotes a number of the authors mentioned above, without himself taking a position in relation to the problem.

In summing up, it may be established that the term "traumatic nephritis" is generally accepted except by KIRSCHNER-NORDMANN who introduced the concept "traumatic nephrosis". It appears from the literature, however, that there is not agreement on the nature of the nephritis, although a number of authors consider it to be an interstitial aseptic nephritis. The concept interstitial nephritis should in view of the focal lesions be considered motivated, but the term traumatic nephropathy should perhaps rather be adopted, owing to the specific urinary finding with positive Heller test and white cells without the presence of bacteria.

It should be noted that the red cells disappear at an early stage, while the white cells, as well as a positive Heller, may remain for several months after the lesion. This is not exactly what one would expect in a nephritis and the reflection lies close at hand that this finding might be the expression of a progressing healing process, in principle reminiscent of a common wound healing. It is also of importance to inquire for trauma in the anamnesis, in the presence of albumin and white cells in the urine. The absence of bacteria may in a number of cases easily give rise to a suspicion of urogenital tuberculosis, as appears from the X-rays of the female patient. The changes of the renal pelvis together with the calcium precipitates projected over the kidney constitute a picture deceptively similar to a renal tuberculosis, but the changes with a traumatic genesis are generally reversible, this being established by subsequent roentgenograms (cf. SCHEEL 1948).

Summary.

In connection with two cases of subcutaneous unilateral rupture of the kidney, the authors present a short survey of this injury and its sequels, especially the so-called traumatic nephritis. The course of healing has, in both of the cases presented, run entirely

parallel with the roentgenologically established healing process, as appears from a number of intravenous urograms. — The possibility of mistaking the condition for urogenital tuberculosis is also mentioned.

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Dicoumarol in Experimental Thrombosis.

By

KNUD F. JANSEN and ERIK TAGE-HANSEN.

Numerous clinical reports on the treatment of venous thrombosis with anticoagulants, tell of successful results in shortening the course of the disease and in decreasing the frequency of embolic complications. However, owing to the difficulty of having a control series comparable in every way with the treated cases, there must still be some doubt as to whether or not the favorable results are in fact due to the use of anticoagulants. Too often during the long period which elapses, while one is collecting sufficient clinical material, the treatment of these cases undergoes considerable modification.

The purpose of this report is to investigate the effect of the anticoagulant Dicoumarol, not in the human subject, but in the experimental animal where a strictly comparable control group can more readily be studied.

A lesion of the intima of the vessel is generally considered to be the first stage in the thrombotic process. This may be caused by anoxia or by inflammation combined with more or less alteration in the clotting mechanism of the blood. An artificial venous thrombus may be produced experimentally by chemical agents as silver nitrate (YATSUSHIRO) or ferric chloride (HUNZIKER). Sclerosing agents such as used in the treatment of varicose veins have also been used to induce thrombosis in animal experiments. BINGHAM, MEYER and POHLE (1941) used the last technique in dogs and demonstrated a delay in thrombus formation during treatment with Dicoumarol. Short periods (minutes, hours) however are most commonly used for the experiments. In our experiments it was thought better to extend the period of observation to a matter of days or even of weeks.

For the experiments here described rabbits varying in weight from 2 to 2½ kilograms have been used. Under ether anesthesia the abdominal cavity is opened and the inferior vena cava is isolated below the renal veins. About 1 cm of the vein is treated with crystalline silver nitrate. A marked constriction of the vessel takes place. The vein is then covered by a peritoneal flap, and the abdominal wall closed.

Experimental thrombosis has been produced in this way in two groups of rabbits. They were subsequently treated in exactly the same way, except that in the second group only was Dicoumarol administered.

1. *Experimental Thrombosis, no Dicoumarol.*

This group comprises 14 rabbits in which thrombosis was produced by the technique described. All the animals were killed on the third day after operation except 3, which died on the third or fourth day from bleeding into the abdominal cavity or from edema of the lungs. Autopsy revealed in all the animals, in the treated area of the vein a fixed massive thrombus filling and distending the vein for a length varying from 1.5 to 2.5 cm. There was also found a secondary thrombus in the inferior vena cava below the treated area extending into the iliac veins. This latter thrombus was not adherent to the walls of the vein nor did it obliterate the lumen completely. The histological picture was identical with that of spontaneous venous thrombus. The silver nitrate in addition produced a marked aseptic inflammation followed by necrosis.

All the 14 rabbits in the control group demonstrated thus a massive thrombus in the inferior vena cava.

2. *Experimental Thrombus Treated by Dicoumarol.*

In this group the thrombus was produced in the same way, but Dicoumarol was given. The absence or the disappearance of a thrombus in this group is thus a certain indication of the effect of the administration of Dicoumarol.

The Dicoumarol was applied in doses, which in gm per kilogram pretty well correspond to those used in patients (0.5—1 cg per kilo). The prothrombin level was determined in blood samples from the ear veins by the Quick method modified by LARSEN & PLUM. The effect on the prothrombin time was generally more marked than is seen clinically. The well-known individual variation

Table 1. Group 2 a.

Low prothrombin level at the time of operation, which was carried out on the 4th day of treatment.

Days	1	2	3	4	5	6	7	8
Animal no	Prothrombin time (in secs)							
177		16	49	160	dead			
182			20	46	200	dead		
184			19	45	77	dead		
188			20	40			1,000 (killed)	
191	20			77	dead			
192	19		92	70	dead			
193	19		72	35	29	62	288	(118 killed)

in response to Dicoumarol was also observed. In a few cases vitamin K was required to limit the Dicoumarol effect.

The experiments in this group were varied in the following way. In the earlier cases the prothrombin time was prolonged by Dicoumarol before the operations as a prophylactic measure (group 2 a). In the later cases (group 2 b) the Dicoumarol was given only after the operation. In these cases there was presumably a thrombosis present at the beginning of the treatment, so in these cases the therapeutic value of the drug was studied.

In group 2 a (table 1) most of the animals died on the first or the second postoperative day from bleeding into the abdominal cavity. In no case at autopsy was found any extensive thrombus in the caval or in the iliac veins. Only in area treated with silver nitrate there was found a small thrombus adhering to the wall, but only partially obliterating the lumen. The diminished coagulability of the blood prevents in this group the growth of the thrombus. At the same time however it leads to the death of the animals from uncontrollable bleeding. The period of survival was, as a result, not so long as in the control group.

The experiments were therefore continued in group 2 b, in which the decrease in prothrombin level occurred shortly after the operation.

In this group (table 2) in one rabbit only (No 198) there was found a thrombus extending into the distal part of the vein. In all the other cases the thrombus was limited to the treated area and was not completely occluding the lumen. In the cases in which death did not occur soon, the thrombus was in a state of orga-

Table 2. Group 2b.

Prothrombin level normal on the day of operation (2nd day) but low on the following day.

Days	1	2	3	4	5	6	7	8	9	10
Animal no	Prothrombin time (secs)									
185	20	30	dead							
186	18	28	98	1,200 (killed)						
187	19	27		(killed)						
11	19	25	70	dead						
12	20	20	40	dead						
13	18	24	80	dead						
14	20	25	dead							
15	20	24	70	270	180 (killed)					
190		20	30		960	2 400	60	54	21	20 (killed)
195		20	57		102	280	25	95	20	34 (killed)
196		21	50	47	70	40	24	630	31	33 (killed)
197		19	42	180	1,320		35	22	1 200	25 (killed)
198		20	39		50	31	20	50	19	25 (killed)

nisation with recanalisation. In 2 animals (Nos 196 and 197) it was impossible even by microscopy to find any trace of thrombus in the lumen, yet the usual reaction in the vein wall had followed the silver nitrate treatment.

The results reported demonstrate that under the experimental conditions described, the growth of a thrombus can undoubtedly be limited by the use of the anticoagulant Dicoumarol. It is unlikely that Dicoumarol could prevent the initiation of thrombus formation which at the outset consists of no more than agglutination of the plates without any real coagulation process. Dicoumarol has no effect whatsoever on agglutination of the platelets.

The conclusion that can be drawn from these experiments, is that Dicoumarol by means of its anticoagulative effect is a potent remedy in the prevention of secondary thrombosis even if it is not capable of arresting thrombus formation at the outset.

Summary.

In rabbits experimental thrombus formation was produced by treating the inferior caval vein with crystalline silver nitrate. By autopsy one to several days after the operation was found a local inflammation in the operation area and an extensive coagulation thrombus in the caval vein and frequently in the iliac veins.

In a second group Dicoumarol was given before and after the operation and in a third group Dicoumarol was given from the time of operation. In neither of the Dicoumarol treated groups any coagulation thrombus was observed in the caval or iliac veins. Only in the area treated with silver nitrate a limited thrombus occurred in connection with the chemical inflammation and in some animals was even that thrombus absent. The results demonstrate a thrombus-inhibiting action of Dicoumarol under the conditions described.

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Ureterovesicostomy as a Treatment of Congenital Stenosis of the Lower Part of the Ureter.

By

HARALD ABRAHAMSEN.

Attention has long been focussed on the patho-anatomical changes which may occur at the site of junction between pelvis and ureter. The author needs only mention aberrant vessels, stenoses, valve formations and abnormal site of junction between ureter and pelvis. A rich literature is found on these conditions, and we know the measures to be taken to amend them, *i. e.* conservative operations, which make it possible to save the kidney.

Anomalies of the lower part of the ureter, on the other hand, have been rather neglected so far. Yet stenoses are perhaps more frequent here than in the upper part, but they are often diagnosed so late that the patient is either moribund on admission or has developed complications so severe that a conservative operation preserving the kidney is impossible. To quote an example, KRETSCHMER, in 1933, collected 15 cases of children with obstructed flow from the ureter into the bladder. Nine of these cases were infants under the age of 7. All died on or shortly after admission, and in most of the cases the condition had not been diagnosed.

In Department D of the Bispebjerg Hospital we saw 14 cases of stenoses in the lower part of the ureter between the spring of 1938 and the autumn of 1948. 6 of these cases were right-sided (in 2 only one kidney), and 6 left-sided (in 1 only one kidney), while 2 were bilateral.

The author shall mention first the patho-anatomical changes found during the operation, which proved to be practically identical in all cases. The dilated ureter generally goes with the peri-

toneum when the latter is pushed aside during the operation. The ureter may then bear a striking resemblance to a small intestine. It often presents peristalsis after having been detached. The diameter of the upper part of the ureter is now found to vary, being, however, most often that of a finger. The wall is somewhat thickened. By detaching the lower part of the ureter we find the most distal portion to be embedded in fibrous, sclerosed tissue. After removal of this tissue 3 or 4 cm of the ureter appears as a cord the thickness of a knitting needle. The transition from the dilated to the stenosed portion may be either abrupt or gradual. In the latter cases the ureter gets a more conical appearance. The inferior portion feels firm and thick-walled, and only a thin bougie (No. 7) can pass through the lumen. However, in two cases the ureter was seen to be dilated right down to the bladder. The stenosis proved in these cases to be intramural. Here, too, the author could pass only bougie No. 7 down through the lumen. — Thus, in 12 of the 14 cases we found a marked stricture of the ureter, after the inferior portion of the latter had been dissected free. But in addition we found in 7 of these 12 cases a cord proceeding from the apex of the bladder, at first embedded in the upper lateral side of the bladder, then lying free beside it, and finally bending — almost at a right angle — down and outwards. Like a hook it constricted the stenosed part, from where it continued its course down to the hypogastric vessels. While dissecting free the lower part of the ureter we always had an impression that this cord compressed the ureter, thus being possibly the proper cause of the stenosis. That this cord must originate from a vessel existing in foetal life was further borne out by the fact that pulsation could be felt in 6 cases. Most likely it was a persisting umbilical artery. In still another case did we find such a vascular cord, which, however, caused no compression. It was in one of the cases with intramural stenosis.

The *intravenous pyelograms* show considerable dilatation of pelvis and ureter. Since in each case of hydronephrosis and hydro-ureter we must try to make an aetiological diagnosis in order possibly to submit the patient to causal treatment, it is of great importance to have the ureter examined in its entire length. The ureter is as a rule 2 to 3 cm broad as far as a few centimeters from the bladder, when it narrows down to *a thin tube of a smaller caliber than that of a normal ureter*. (Fig. 1.) This narrowing is not always seen in the intraven. pyelogram, because the shadow of the bladder

may conceal this portion, but is always plainly visible by direct pyelography. In some cases the transition to the dilated portion is here seen to be abrupt, while in other cases it is more conical. This is a finding of importance for the diagnosis, for it proves at once that we have to do with a stenosis and not with "megalo-ureter". *Cystoscopy* was done in all cases, except in those of the 2 infants under 12 months of age. No changes were demonstrated at the opening of the ureter into the bladder. In addition it may be noted that X-ray examination in 2 cases revealed calculi in the ureter. In one of these we removed 9 calculi, from pea- to hazel-nut-sized, and in the other one calculus.

Symptomatology.

Colic is not a predominant symptom at the first stage of the disease; neither is the pain always characteristic and well-defined. In many cases the patients feel only a dull sensation or constant and vague aches and pains, often referred to the lower part of the abdomen. The disease is frequently mistakenly diagnosed as appendicitis and appendicectomy done. This vague symptom-complex often prevails as long as the urine is *sterile*, and at this stage attacks of colic are rare. As soon as *infection* occurs the symptoms become accentuated in various ways. Colic on the affected side is now a frequent symptom, and the pains irradiate characteristically downwards towards the bladder. These attacks are often associated with frequency and urgency of micturition, as well as with fever and pyuria, effecting the general condition. We must not forget, however, that in some cases there are found no symptoms whatever, while in others pyuria may be the only symptom present. A number of the children of the present series had, after a long symptom-free period, presented intermittent pyuria, now and then attended by a rise in temperature, but never by colic. These cases had been diagnosed as pyelitis. The pyuria having often disappeared after confinement to bed and treatment with antiseptics, the parents and the therapists had left it at that, until the cases recurred again and again, or attacks of colic or temperature rises supervened, so that hospitalisation became necessary. One patient, a woman aged 25, developed pyuria during her first pregnancy. The pyuria vanished after parturition, but recurred during her next pregnancy, this time attended by fever. The condition having now become stationary, she was admitted

for further examination, which disclosed the stenosis. Another patient had been feeling well till the age of 20, when she developed pyuria in connexion with angina. The condition being later complicated by pains and a rise in temperature, she was admitted to hospital. These instances give occasion to point out that pyuria, in particular the recurrent form, should always prompt one to thorough urinary tract examinations. Use should be made here of the special urological aids, notably excretory and retrograde pyelography, which have made it possible to demonstrate this anomaly before irreparable damage has been done to the kidney.

As is well-known, the stenoses in the ureter are generally situated just below the pelvis, close to the bladder or in the wall of the latter, in other words at the sites of the physiological contractions. The stenosis in the inferior part of the ureter may be due to an inflammation arising from a lesion in the adnexa, as pointed out particularly in American literature, where various writers (HUNNER, LIVERMORE, GREEN, EISENDRATH, BOTTOMLEY) mention these complications. Cancer of the uterus or a trauma following operation, notably Wertheim's operation for cancer of the uterus, may likewise be the cause. Finally we have the congenital stenosis, where the lower part of the ureter is found embedded in fibrous tissue, and often further compressed by a cord or vessel persisting from foetal life. This stenosis is generally overlooked, because the details can be elucidated only by careful dissection during the operations. It is impossible to explain the causative relation between cord formation, fibrous tissue formation and stenosis. During the operations we had an impression, as stated above, that the cord formation plays an essential part. It is less likely that a chronic inflammation should occur in such a limited area without signs of a previous inflammation in this place being demonstrable in the past history.

How are we then to *treat* this anomaly? While the stenosis of inflammatory origin seen in adults is treated conservatively — bougie treatment giving good results (HUNNER) — it is necessary to adopt another method in the treatment of this form of stenosis, which is fibrotic and sclerosed. Treatment with bougies can be expected to produce no more than a transitory effect, with fairly prompt recurrence of the stenosis. Another point of importance is the age of the patient. This stenosis being most often diagnosed at a fairly young age, it would be very difficult to carry through a treatment consisting in repeatedly passing graduated bougies

up through the ureter. The majority of these patients are not treated correctly. This is due among others to the fact that the disease often is diagnosed so late that removal of kidney and ureter is the only possibility. In other cases the disease is diagnosed as one of congenital "megalo-ureter", on the analogy of megacolon, and it is attempted, through operations on the central nervous system, to restore the ureter to its normal dimensions, but without success. Only if it is realized, through X-ray examinations, that it is a question of a stenosis at the opening to the bladder, and if the diagnosis is made at a fairly early stage, when active renal tissue is still left, can the kidney be efficiently drained by making an anastomosis between ureter and bladder, *i. e.* by doing ureterovesicostomy. This operation has fallen somewhat into discredit, since at a meeting of the French Urological Society in 1925 PASTEAU, MARION, LEGUEU, and others called it "*une opération dangereuse et sans valeur*", "which always results in destruction of the kidney". Indeed, the operation under discussion was not performed for congenital stenosis, but for the purpose of cutting the ureter and implanting the normally calibrated ureter into the bladder. The reason why the author nevertheless made up his mind to perform this operation was the following: — in 1938 a boy, aged 4 years, was admitted to this department. He had only one kidney, which was in a rather bad condition owing to two stenoses of his ureter, one half-way between kidney and pelvis and the other one at the ureterovesical junction. Consequently kidney and pelvis were dilated, and in addition there was infection. The child being likely to die in the near future, the author decided on operation. Ureterovesicostomy was done at the lower end and a plastic operation performed at the site of the upper stricture. At the same time the kidney was mobilized and displaced downwards to avoid tension. The result was surprisingly good, the infection subsided and the patient did well in all respects. Repeated follow-up examinations have shown sterile urine and the dilated areas have shrunk considerably. He lived in good health until 4 years after the operation he died of heart disease. His urine was then normal.

Encouraged by this result the author performed the operation 15 times (once on both sides) within the following 10 years. Three of the patients had only one kidney (in one case the right one was absent, and in two the left) and the operation was, therefore, here of life-saving importance. In two cases the disease was bilateral.

Ages of the patients: 2 were under 12 months, 4 between 1 and 6 years, 4 between 7 and 11, and finally 4 were 20, 22, 25, and 40 years of age respectively; a total of 14, of whom thus 10 were children between the ages of 11 months and 11 years.

The *procedure* was briefly as follows: — Prior to the operation the external genitals and the thighs were carefully disinfected and covered by sterile towels. Then a sterile Pflaumer's catheter No. 10 or a Pflaumer's ureteral catheter was introduced into the bladder, in such a manner that it could be pushed up through the bladder and the ureter after the first part of the anastomosis had been made. Next the anterior part of the anastomosis was completed. In 12 out of the 14 cases the anastomosis was carried out like an ordinary side-to-side gastro-enterostomy, and in the remaining cases as an end-to-side anastomosis, the cut dilated stump being implanted direct into the bladder. Finally a layer of fatty tissue was sutured over the anastomosis, and a small rubber tube was left behind extending right down to the bladder wall. During the following 10 days the pelvis was washed out daily with a light antiseptic, after which the catheter was removed. During this period, and possibly a few days more, mandelic acid or sulphathiazole was administered, and within recent years penicillin or streptomycin. In two of the patients there was slight oozing of urine for from 5 to 14 days. These two also presented a rise in temperature. The wounds healed up in all cases after 2 to 3 weeks from the day of operation.

In the following the case histories of the 14 patients treated in the Department within the past 10 years will be rendered in brief.

No. 1. Boy, aged 4 years. In hospital $25/3-22/5$ 1938. *Left. Symptoms:* pyuria, fever, and later pain in the left side. *Urine:* many leukocytes and growth of coli. *Intraven. pyelogram:* right kidney absent. Left side considerable hydronephrosis as well as dilatation of the ureter. There is stenosis both at the middle of the ureter and close to the bladder. *Findings on operation:* stenosis of the ureter just above the bladder, and another 8 cm higher up. *Plastic operation of the ureter for the upper stenosis,* and *end-to-side ureterovesicostomy for the lower,* the ureter having been cut just above the stenosis and implanted into the bladder. The kidney mobilized downwards to avoid tension at the sites of operation. *Course:* follow-up autumn 1942. Well-being in every respect, does well. *Urine:* crystal clear, normal, no leukocytes, no bacteria. *Intraven. pyelogram:* Slight distention of the pelvis, unobstructed outflow to the bladder. — Some months later he developed severe heart attacks and died within a few days. His physician states that the

urine was examined then and found to be perfectly normal ($4\frac{1}{2}$ years after the operation).

No. 2. Girl, aged 9 years. In hospital $5/6-20/7$ 1938. *Right. Symptoms:* has been suffering from nocturnal enuresis and pyuria for several years. *Urine:* an abundance of leukocytes and growth of coli. *Intraven. pyelogram:* pronounced dilatation of right ureter and renal pelvis. *Findings on operation:* right ureter the thickness of a finger. A cord proceeds from the apex of the bladder, at first embedded in the latter, but then running free along the side of the bladder, finally to turn at a right angle and pass hook-like round the ureter. — The lower part of the ureter dissected free and proved to be thin like a knitting needle along 3 to 4 cm. *Side-to-side ureterovesicostomy. Course:* follow-up $4/11$ 1948. *Urine:* crystal clear. No pain, no dysuria, does well, no bacteria, no enuresis. *Intraven. pyelogram:* Slight dilatation of right ureter and right pelvis. Good outflow. *Cystoscopy:* the new ostium lies on the same "meridian" as the old one, is about twice as big as the left one, not drawn up to a level with the surrounding vesical wall. We can look some way into the ureter and see the walls contract, so that a peristaltic wave passes down to the ostium, sending clear urine into the bladder (10 years after the operation).

No. 3. Woman, aged 25. In hospital $10/6-20/7$ 1938. *Right. Symptoms:* pains in right loin and right iliac fossa of several years' duration. *Urine:* normal. *Cystoscopy:* right ureteral orifice normal, no orifice on the left side. *Intraven. pyelogram:* pronounced hydronephrosis and dilatation of the right ureter with conical tapering of the lower portion. *Left kidney absent. Findings on operation:* right ureter the thickness of a finger; the distal 3 to 4 cm embedded in fibrous tissue, dissected free, the thickness of a knitting needle. *End-to-side ureterovesicostomy.* The ureter implanted into the bladder. *Course:* follow-up $4/11$ 1948. Feels well and is physically fairly strong; gives lessons 5 hours daily and looks after her own house. *Urine:* sterile without formed elements. *Intraven. pyelogram:* no dilatation, good excretion, good outflow (10 years after the operation). (Fig. no. 2 and 3.)

No. 4. Boy, aged 8 years. In hospital $17/3-25/5$ 1938. *Left. Symptoms:* pyuria and pain in the left side of several years' duration. *Urine:* numerous leukocytes, growth of coli. *Cystoscopy:* bladder normal. *Intraven. pyelogram:* considerable dilatation of left ureter and left pelvis; calculus in the ureter. *Findings on operation:* ureter the thickness of a thumb, of which the distal 3 cm embedded in firm, fibrous tissue. A cord proceeding from the apex of the bladder winds across this tissue. It passes along the bladder and then turns away from it at a right angle, like a hook round the ureter. *Side-to-side ureterovesicostomy. Course:* follow-up $7/2$ 1942. *Cystoscopy:* the left ureter acts, looks like a cod's mouth, which opens and closes. *Intraven. pyelogram:* still some dilatation of ureter and pelvis. 1946 *intraven. pyelogram:* dilatation reduced. *Urine:* normal. In 1948 the patient was operated on for ileus. *Urine:* normal. No pain in the left side. Died of paralytic ileus. *Post-mortem finding:* light dilatation of ureter and pelvis (10 years after the operation).

No. 5. Boy, aged 11 months. In hospital $1/8$ — $23/8$ 1939. *Left. Symptoms:* attacks of fever attended by vomiting and diarrhoea of a few months' duration. *Urine:* many leukocytes and growth of coli. *Intraven. pyelogram:* right side normal, left side considerable dilatation of ureter and pelvis. Ureter tapering conically towards the bladder. *Findings on operation:* ureter the thickness of a finger, distal 2 or 3 cm embedded in fibrous tissue, dissected free. A cord is found from the apex of the bladder lying along its side, from where it passes round the lower portion of the ureter like a hook and makes for the hypogastric vessels. Abrupt transition from the dilated to the constricted portion of the ureter. *Side-to-side ureterovesicostomy. Course:* follow-up $10/11$ 1948. Feeling well, no pain nor dysuria. *Urine:* clear, containing no formed elements. *Intraven. pyelogram:* on the left side prompt excretion, calices slightly dilated, somewhat greater dilatation of pelvis and ureter ($9\frac{1}{4}$ years after the operation).

No. 6. Woman, aged 22. In hospital $1/12$ 1939— $1/3$ 1940. *Right. Symptoms:* well till her first pregnancy, during which pyelitis, cold shivers, temp. 40° C. The attacks subsided and disappeared after parturition. During her next pregnancy again pyelitis, which persisted. She now got attacks of colic and intermittent rises in temperature. *Urine:* on admission many leukocytes and growth of coli. *Intraven. pyelogram:* pronounced dilatation of right pelvis and ureter. *Retrograde pyelography:* about 3 cm of the prevesical portion of the ureter is seen as a contrast streak the thickness of a knitting needle, while the rest is markedly dilated. *Findings on operation:* the distal few centimeters of the ureter embedded in tightening fibrous tissue, dissected free. No cord demonstrable. *Side-to-side ureterovesicostomy.* The condition improved, but not quite good. As she continued to have pain over her loins and her urine could not be made normal, and, moreover, the hydronephrosis seemed to increase in severity, *nephrectomy and ureterectomy were done Nov. 20, 1942.* Kidney small, of foetal appearance: $9 \times 5 \times 20$ cm, irregular with minor lobes and grooves. It is a case of pyelonephritic atrophic kidney. The parenchyma less than 5 mm thick in some places and in others of almost normal thickness. Pelvis the size of a hen's egg. Mucous membrane smooth and reflecting, no ulcerations. Ureter scarcely the thickness of a little finger. Superiorly considerable winding of the ureter, which has an upwards turned valve. The entire ureteral wall much thickened.

No. 7. Girl, aged 5 years. In hospital $21/10$ — $8/11$ 1939 and $1/12$ — $20/12$ 1940. *Left. Symptoms:* "gastric pain" and pyuria of some years' duration. *Urine:* growth of coli. *Intraven. pyelogram:* pronounced dilatation of pelvis and ureter till 2 cm from the bladder, where the ureter tapers conically. *Cystoscopy:* normal conditions. *Findings on operation:* ureter the thickness of a little finger. 2 vessels (pulsation) pass from the apex of the bladder down along its side and turn like a hook round the lower portion of the ureter, attended by fibrous cords. Ureter dissected free. *No anastomosis was made,* because the stenosis did not seem particularly pronounced, and the compression seemed to be due chiefly to the vessels. *Course:* the urine became normal, the attacks subsided,

but soon after the patient developed pain and pyuria, which persisted. Hence *nephrectomy* and *ureterectomy* were done Dec. 6, 1940. Scar formation over the lower 10 cm of the ureter, so that no anastomosis could be made. Renal parenchyma normal to look at. Pelvis slightly distended. Ureter dilated in its entire course as far as the point of cutting close to the bladder, where it is extremely narrow with a small lumen and with cicatricial, very thick tissue. The rest of the ureter likewise has markedly thickened wall, which, however, is not due to cicatricial tissue, but is to be regarded as a pronounced hypertrophy of the muscles. Only at the inlet to the pelvis do we find a wall corresponding to the age. *Microscopy*: 1) Section from the *upper* portion slight fibrous thickening of the proper coat, moderate round-cell infiltration, muscles somewhat hypertrophic. 2) From the *central* portion: moderate round-cell infiltration, muscles more hypertrophic than in the proximal portion. 3) From the *lower* portion (the stricture): moderate round-cell infiltration. The proper coat presents considerable fibrous thickening. Furthermore there is seen very pronounced hypertrophy of the interstitial connective tissue of the muscular coat, and the muscle bundles are hypertrophic and more irregularly arranged than further proximally. Mucous membrane normal throughout.

No. 8. Girl, aged 11 years. In hospital $^{20}/_3$ — $^{24}/_5$ 1941. *Bilateral stenosis*. *Symptoms*: repeated attacks of pyelitis and temperature rise since the age of 12 months. Several times treated in hospital for pyelitis, after which improvement, but soon relapse. *Cystoscopy*: Normal conditions. Ureteral ostia normal with normal, rhythmic action, normally situated, no signs of ureterocele. *Intraven. pyelogram*: greatly dilated ureter and hydronephrosis on the left side, less so on the right side. *Findings on operation*: left ureter the thickness of a thumb. Pulsating cord from the apex of the bladder, at first embedded in the wall and then lying free along the bladder, from where it turns at a right angle hook-like round the ureter to pass further down to the hypogastric vessels. The lower end of the ureter dissected free, the thickness of a knitting needle. *Side-to-side ureterovesicostomy*. 1 month later operation on the right side. Pulsating cord like on the left side. Conditions analogous to those of the left side, but the fibrous changes less pronounced. The vessel was ligated, and we had the impression of having removed the factor obstructing the outflow. Hence *we made no anastomosis*. *Course*: follow-up $^{22}/_{11}$ 1948. No sick-days since the operation, no lumbar pains. *Urine*: quite clear without leukocytes ($7\frac{1}{2}$ years after the operation).

No. 9. Woman, aged 20. In hospital $^{25}/_6$ — $^{30}/_{11}$ 1941. *Right. Symptoms*: repeated attacks of pyelitis since the age of 8 years, but without temperature rises. 2 days before admission cold shivers, fever, pyuria, pains in the right side; growth of coli. *Cystoscopy*: Normal conditions. *Urine* from the right kidney leukocytes, growth of coli. *Intraven. pyelogram*: large pelvis. Ureter 2 cm broad, dilated, seems to end close to the bladder. *Left kidney absent*. *Findings on operation*: ureter the thickness of a thumb. 3 to 4 cm from its opening into the bladder there is found a fibrous cord proceeding from the apex of the

bladder and passing across the ureter. It does not seem to compress the ureter. The ureter dissected free to the bladder without any stenosis being found. The ureter is opened, bougies meet with obstructions in the very vesical wall; No. 8 passes into the bladder (constriction of the very vesical wall). *Side-to-side ureterovesicostomy. Course:* follow-up November 1948. Feeling well, no dysuria, general condition good. *Urine:* contains a few leukocytes. *Intraven. pyelogram:* good excretion on the right side, ureter slightly dilated, no stagnation, only inconsiderable dilatation of the calices (7 years after the operation).

No. 10. Girl, aged 4 years. In hospital $2\frac{1}{5}$ — $26\frac{1}{5}$ 1943. *Left. Symptoms:* since the age of 6 months every month or every two months pyelitis with pain, temperature rises to 39—40° C, pyuria. Suffers from enuresis. *Urine:* growth of coli. *Intraven. pyelogram:* left ureter and pelvis considerably dilated. Inferiorly conical tapering of the ureter. *Findings on operation:* ureter the thickness of a thumb right down to the bladder. No cord formation, no stenosis. The ureter is opened. Bougie No. 8 passes unobstructed into the bladder. *Side-to-side ureterovesicostomy. Course:* follow-up December 1948. No pain, no attacks of fever, no dysuria. Does well. No enuresis. *Urine:* normal. Microscopy no formed elements. *Intraven. pyelogram:* pelvis and calices deformed, ureter slender, no obstruction. *Cystoscopy:* Bladder normal ($5\frac{1}{2}$ years after the operation). (Fig. no. 4 and 5.)

No. 11. Woman, aged 40. In hospital $23\frac{1}{3}$ — $18\frac{1}{5}$ 1944. *Left. Symptoms:* repeated attacks of pyuria, slight lumbar pain. *Urine:* growth of coli. *Cystoscopy:* bladder normal. *Intraven. pyelogram:* bilateral hydronephrosis. *Right side* only pelvis distended (aberrant vessels). *Left side* considerable hydronephrosis of both calices and pelvis. Ureter 3 cm broad, tapers conically towards the opening into the bladder. *Findings on operation:* right side ligation of the aberrant vessels. Left side ureter thicker than a thumb; the most distal 3 to 4 cm covered by firm, infiltrated tissue. This portion is dissected free, and the lower 2 or 3 cm prove to be like a thin knitting needle. *Side-to-side ureterovesicostomy. Course:* follow-up November 1948. Feeling well, no pain or attacks of any kind in the left side, slight right lumbar pain. *Urine:* crystal clear. *Intraven. pyelogram:* prompt excretion on both sides, good filling of the urograms, no dilatations. Right side unobstructed outflow to the bladder. Left side slight dilatation of the inferior portion of the left ureter, but the previously observed large dilatation has gone ($4\frac{1}{2}$ years after the operation).

No. 12. Girl, aged 9 years. In hospital $4\frac{1}{7}$ — $20\frac{1}{7}$ 1945. *Right. Symptoms:* a year ago colic-like pain in the right flank. *Urine:* few leukocytes, no growth. Later pyuria, growth of coli. *Cystoscopy:* Normal bladder, ureteral ostia normal. *Intraven. pyelogram:* right side: pronounced hydronephrosis, considerable dilatation of the entire ureter right down to the bladder, where the ureter tapers conically. *Findings on operation:* ureter the thickness of a thumb, narrows down funnel-like the last few centimeters above the opening into the bladder. No hook-like cord. The ureter cut 1 cm from the bladder, and the peripheral stump implanted into the bladder. *End-to-side ureterovesicostomy. Course:* Letter from the mother November 1948. There have been no

pains or temperature rises since the operation. Does well in every respect. *Urine*: normal ($3\frac{1}{4}$ years after the operation).

No. 13. Boy, aged 6 years. In hospital $\frac{22}{8}$ — $\frac{22}{12}$ 1945. *Bilateral stenosis. Symptoms*: intermittent fever and dysuria of several years' duration, temperature rises to 41° C. *Urine*: growth of coli. Treated repeatedly with sulfonamide. *Intraven. pyelogram*: bilateral hydronephrosis, both ureters dilated right down to the bladder, where they taper just above the opening into the bladder. *Cystoscopy*: bladder normal. *Findings on operation*: right side ureter the thickness of a little finger. The distal 3 to 4 cm dissected free, the ureter here the thickness of a knitting needle. A pulsating cord proceeding from the apex of the bladder passes down along its wall and from there hook-like round this part of the ureter. *Side-to-side ureterovesicostomy. Course*: follow-up $\frac{11}{11}$ 1948. No cases from the urinary tracts, no pain in the right side, nor in the left. No dysuria. Appetite good, does well. *Urine*: normal; microscopy no formed elements. *Intraven. pyelogram*: slight dilatation of right ureter and pelvis, more pronounced dilatation of left. We must be prepared of signs and symptoms in the left side, in which case he must be admitted for operation (3 years after the operation).

No. 14. Boy, aged 15 months. In hospital $\frac{1}{5}$ — $\frac{8}{6}$ 1946. *Right. Symptoms*: since the age of 4 months attacks of fever up to 40° C of a few days' duration with pyuria. *Urine*: growth of coli. *Intraven. pyelogram*: right hydronephrosis, dilatation of the right ureter, in the lower portion of which there is seen an accumulation of concretions. *Findings on operation*: right side: ureter the thickness of a finger, a calculus on its way up into the kidney, conveyed down, clamp on the ureter. The distal 2 cm of the ureter like a knitting needle, embedded in firm, fibrous tissue. 9 calculi removed. Next *side-to-side ureterovesicostomy*. Subsequently one more calculus was demonstrated (overlooked at the former operation?) and removed. *Course*: December 1948 well-being in every respect, does well. *Urine*: few leukocytes. *Intraven. pyelogram*: slight dilatation of pelvis and calices.

As a supplement mention may be made of a case of ureterovaginal fistula in a woman, aged 48, developed after ant. colporrhaphia, and cured after ureterovesicostomy.

Woman, aged 48. In hospital $\frac{12}{8}$ — $\frac{22}{9}$ 1943. All urine from the left side passed through the top of the vagina. As closing of the fistula in this place would be extremely difficult, we did suprapubic cystotomy, detached the normally calibrated ureter, and finally performed implantation inferiorly to the left into the bladder. A few silk knotted sutures were made posteriorly between bladder and ureter. Pflaumer's catheter No. 9 was passed through the opening in the bladder up into the ureter, after which sutures anteriorly. Healing by first intention. Cystoscopy 1 month later the new left ureteral ostium situated superiorly to the left; opening slightly bigger than that of a normal ostium. Distinct sphincter-like contractions of the ostium and emission of urine into the bladder. *Follow-up* $\frac{25}{11}$ 1948: no dysuria, no pain, urine normal. *Intraven. pyelogram*: good excretion and good outflow, no dilatation of left ureter or renal pelvis.

	No.	Years after operation	Urine	Intravenous pyelogram
1 kidney	1	4½	normal	no dilatation of the ureter, slight dilatation of the pelvis
	2	10	normal	slight dilatation of the ureter
1 kidney	3	10	normal	no dilatation of the ureter
	4	10	normal	slight dilatation of ureter and pelvis
	5	9¼	normal	some dilatation of ureter and pelvis
	6	—	—	No effect of operation because of valve formation higher up in the ureter. Hence nephrectomy 1 year later
	7	—	—	No anastomosis made, only lower portion of ureter dissected free. This having no effect, nephrectomy was done
Bilateral	8	7½	normal	
1 kidney	9	7	normal	slight dilatation of the ureter
	10	5½	few leukocytes	slight dilatation of ureter and pelvis, calices deformed
	11	4½	normal	slight dilatation of the ureter inferiorly
	12	3½	normal	no intraven. pyelogram. No pains, does well in every respect
Bilateral	13	3	normal	slight dilatation on right side (operated on), more pronounced dilatation on left side (not operated on)
	14	2½	few leukocytes	slight dilatation of the ureter and calices

By reviewing case histories we find (see Table) that the uretero-vesicostomy had a favourable effect in most of the cases, having even no doubt been life-saving in the cases with only one kidney left. None of the patients died during or immediately after the operation, and subsequent death was in no case due to renal changes. The first patient operated on, No. 1, who had only one kidney, and on whom plastic operation and anastomosis were performed, lived in good health for 4½ years. Urine then normal. He died of heart disease.

Another patient (No. 4) died 10 years after the operation from ileus. On admission to hospital his urine was normal, and there were found no symptoms from the kidneys. That the operation had been of the greatest importance in this case appeared from the post-mortem examination, which revealed only slight dilatation of ureter and pelvis with good renal parenchyma.

Nephrectomy was done in 2 of the remaining 12 cases. In one of these, No. 6, we found, when ureter and kidney were removed,

that in addition to stenosis inferiorly, there was an upwards directed valve formation at the middle of the ureter. This complication was suspected on the first X-ray examination, but could not be demonstrated at subsequent examinations. We, therefore, confined ourselves to making anastomosis inferiorly, with no effect, however, owing to the valve formation. In the case of the other patient, No. 7, who had left-sided stenosis, which did not seem particularly pronounced and thought to be due mainly to compression by the vascular cord formations, the author confined himself to cutting of the latter *without making anastomosis*. No improvement was obtained here. The dilatation and the urinary tract infection persisted unchanged. Hence nephrectomy had to be done later. This instance shows that it is not sufficient to cut free the stenosed area, but that anastomosis must be made as well, in order thus to be quite sure of an unobstructed outflow from the ureter. The fact that the 12 remaining patients improved considerably, and a few even no doubt recovered completely after the making of anastomosis is further evidence in favour of this theory. — In a few cases a conspicuous effect is seen within a short time, the dilatation of ureter and pelvis subsiding rather soon, while in other cases the dilatation decreases more slowly. In most patients the ureter remains slightly dilated even after several years. However, if the opening into the bladder is big, and there is no stagnation of urine further up, it seems to play no great part that the dilatation has not vanished completely. The most important point must be that of removing the infection. Our investigations showed the urine to be normal (in 2 cases: a few leucocytes) 4 cases 9—10 years after the operation, 2 cases 7 years, 3 cases 4—5½ years, 2 cases 3 years, and finally 1 case 2½ years after the operation. As, moreover, by cystoscopy of a number of the patients, we found a satisfactory opening from the ureter to the bladder, and as there were found rhythmic contractions of the ureteral ostium with emission of urine to the bladder, and finally no infection was present at the follow-up in 1948, we may conclude that ureterovesicostomy is an appropriate operation for stenosis in the inferior portion of the ureter. It must even be supposed to have saved the lives of the 3 patients with only one kidney. — It must be added, however, that in one case (No. 14), where the author found 9 calculi in the ureter, we unfortunately, during the former operation, overlooked one, which must have slipped into the pelvis. In this case the infection did not vanish till we managed to remove the concrement at a subsequent operation.

In one case (bilateral) the author operated on one side only, with a favourable result. There is still a rather pronounced dilatation in the other side, and the author has advised the parents to let the child be readmitted for anastomosis also on this side.¹

The series of cases here presented is small, indeed, yet large enough to prove that ureterovesicostomy is capable of removing the stagnation, and thus of repressing a possible infection and of preventing a progressive atrophy. It may even lead to regeneration of the very renal tissue.

As a supplement is mentioned a patient with a ureterovaginal fistula, cured after ureterovesicostomy. Ureter was here of normal dimensions. *Follow-up:* 5 years later showed the ureter and pelvis of normal dimensions, and urine normal.

Summary.

A description is given of congenital stenosis of the inferior portion of the ureter. This form of stenosis is no doubt more frequent than supposed so far, but the majority of the cases are not diagnosed till a pronounced hydro- or pyonephrosis has developed, or the patients die before any kind of therapy has been instituted. It is pointed out that the stenosis is demonstrable by X-ray examination, either by intraven or by retrograde pyelography, and that the stenosed area differentiates this disease from the congenital megalo-ureter.

The stenosis was in 13 own cases demonstrated by operation. The stenosed portion was embedded in fibrous tissue, and a cord was often found to lie like a hook around it. This cord proceeded from the apex of the bladder, and was in most cases vascular. After having dissected free the ureter we found the inferior about 3 cm stenosed with a narrow lumen, allowing only bougies No. 7 or 8 to pass through. In 2 cases the stenosis was intramural. Here, too, only bougie No. 7 could pass through.

Ureterovesicostomy is recommended. The stagnation is thereby removed; the dilatation of ureter and pelvis disappear completely in a few cases, while in others it decreases considerably, and the infection, which can now be treated with effect, generally does not recur. Finally this operation may even lead to regeneration of the renal parenchyma.

¹ This side was operated upon, Jan. 49, and the same conditions were found as on the right side. *Findings on operation:* the distal 3 cm. dissected free, a pulsating cord from the bladder passes hook-like round this part of the ureter. Side-to-side ureterovesicostomy.

From the Children's Clinic, University of Helsinki.
(Chief: Professor A. YLPPÖ, M. D.)

On Duplications of the Alimentary Tract.

(Two cases.)

By

M. SULAMAA and L. O. NYBERG.

Among abdominal tumours in children different kinds of mesenteric and omentum cysts as well as lymphangiomas are not such a rare occurrence. More uncommon are the so-called intestinal duplications.¹ The two cases which are to be reported in this paper tally with the definition W. E. LADD and R. E. GROSS established for intestinal duplications, *i. e.* 1) to be attached and adherent to some part of the alimentary tract, 2) to have a layer of smooth musculature, usually in two strata, and 3) to be lined internally with an epithelium corresponding to some part of the ventricle, the small or large intestine.

Case 1. (No. 70/48), girl, born 8/4/47, hospitalised at the age of 8 months, had been in good health before, until her mother, about one month before the admission of the patient to the hospital, noticed a resistance in the upper part of the abdomen which gradually grew larger. There were no other symptoms, aside from the patient having been restless in her sleep for the last few days. — Examination revealed a soft, somewhat movable tumour the size of a man's fist with a firm consistency in the upper part of the abdomen. There was no tenderness, nor any unmistakable fluctuation. The remaining clinical examination as well as blood picture, faeces, urine and urography were noncontributory. A radiological examination of the intestinal canal with a contrast showed a large defect between the colon transversum and the ventricle and signs of an irritated condition in the intestine but no difficulties of passage. (Fig. 1.) Bearing in mind the possibility of a mesenteric cyst, *laparotomy* was carried out (SULAMAA): a large thick-

¹ The term duplication has only recently come into use in the Anglo-Saxon literature and it appears to be better expressive of the whole concept and more adequate than the name of enterocystoma originally introduced by M. ROTH or the more usual denominations such as giant diverticula or inclusion cyst.

walled cyst was found on the mesocolon between the ventricle and the transverse colon. First after having been punctured and drained of a clear but fairly dark secretion, it could be got out from the abdomen. It was then possible to detach the whole tumour without any lesion to the supply of blood to the corresponding part of the colon. On a surface of about 3 times 4 cm the tumour was so closely adhering to the transverse colon that it had to be peeled off with a diathermy knife, which was managed without opening the intestinal lumen. After peritonisation the abdomen was carefully closed. Aside from an acute nosocomial gastroenteritis, the post-operative course was free from complications. At a follow-up the child was found to be well and asymptomatic.

A microscopic examination of the cyst revealed an innermost layer of mucous membrane with a high-prismatic epithelium and a scarce lymphatic tissue. This was succeeded by a fairly strong layer of muscular fibres, thereafter collagen connective tissue with blood vessels and nerve fibres. Over this there was a thick muscular lining and on top of it a strong connective tissue layer. On either side of the muscular stratum there were groups of ganglion cells typical of the intestinal walls. (Figs. 2 and 3).

Case 2. (No. 2803/48), girl, admitted to the Children's Clinic the day after birth on 24/8/48 direct from the maternity hospital, owing to an abnormally wide and gaping anus. The clinical examination revealed nothing of significance, the urine, faeces and blood picture as well as the liquor being normal. On examination a fluctuating protrusion the size of a thumb tip was seen through the gaping anal orifice back towards the sacrum which seemed to be affixed to this latter; more to the left. Irrigography revealed normal conditions. Owing to difficulties of passage the tumour was punctured through the left gluteal region on the sixth day, and an oily transparent fluid was recovered. The anus contracted so as to resemble more or less normal conditions. Since the tumour grew again causing difficulties in emptying the intestine and the bladder, 4 additional punctures were made, withdrawing amounts of fluid varying between 15 and 35 ccm. Its total proteins varied from 0.514 mg% to 0.113 mg% and the chlorides between 883 mg% and 708 mg%, there were no bacteria and no fat but some leukocytes, 50 % of which were lymphocytes. Since the passage difficulties persisted, an operation was decided upon notwithstanding the risks and technical difficulties in so young an infant, and at the age of 6 weeks an *extirpation* of the tumour was performed through an incision to the left of the sacrum (SULAMAA). Through keeping a finger in the anus the tumour could be luxated through the wound after dissection. The tumour was found to be the size of a hen's egg, with a surface of about 3 times 4 cm closely adhering to the rectum. After having opened the cyst, one succeeded in peeling off its mucosa from the rectal wall, after which the tumour was excised. The post-operative course was free of complications. The child was treated without bandages under a heated cradle, and on 14/10/48 the patient could be discharged as free from symptoms. At a follow-up examination 21 days after the operation nothing abnormal could be found anymore.



Fig. 1.



Fig. 2.



Fig. 3.

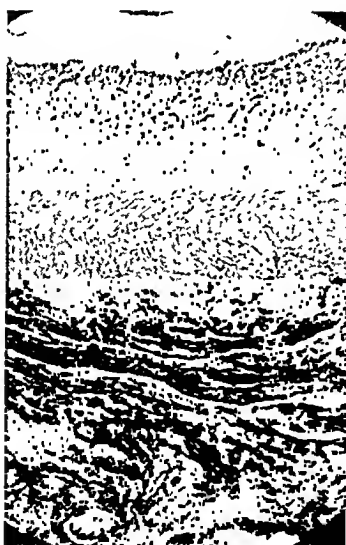


Fig. 4.



Fig. 5.

Macroscopically the inner cyst wall looked like usual intestinal mucosa, and microscopically the inner layer was found to be of a cylindric epithelium and bordering upon a thin layer of connective tissue. On top of this layer a thick muscular stratum was seen, covered by a firm layer of connective tissue. (Figs. 4 and 5.)

D. J. PACHMAN described in 1939 the 36 cases published until then. Yet at least 3 cases have been omitted from his review. In fact B. LÖNNQVIST published such a case in 1907 and in 1926 A. GRÄSBECK described 2 cases of intestinal duplication in Finland. The first consisted of an elongated tumour with a thin torquated stylus the thickness of a pen, starting from a loop of the small intestine. The tumour together with the part of the intestine involved had penetrated through a hole into the mesenterium, causing intense occlusion symptoms. One of GRÄSBECK's cases was almost exactly similar to the one published by A. KROGIUS, with a tumour in the lowest part of the ileum invaginated into the coecum. The second case consisted of a tumour attached about 30—40 cm orally from the coecum in the ileum. The diagnosis of intestinal duplication was microscopically verified in all these cases. All of them made a recovery subsequent to the extirpation.

H. D. COGSWELL and H. THOMPSON recently published a case of duplication of the rectum which was unique in so far as it could be characterised both as a cyst and a diverticulum. In PACHMAN's review 27 of the cysts were localised to the coecum or in the lowest part of the ileum. Of these patients 11 died because of their duplications, whereas 7 succumbed to other irrelevant causes. LADD and GROSS reported in 1947 18 cases of their own. Of them 4 were situated in the immediate vicinity of the coecum, 5 on the small intestine, 1 in the cavity of the mouth, 3 on the oesophagus, 1 near the ventricle, 1 at the duodenum, 1 on the sigmoideum and 1 on the rectum. Not less than 6 of these patients died. The prognosis has therefore proved to be serious. We have been unable to find any previous case with a localisation to the colon transversum similar to our case 1, and a localisation to the rectum, as in our case 2, also seems to be fairly uncommon.

The symptoms can, as in our first case, only involve a slight discomfort and an objectively demonstrable tumour. In addition, there are frequently various occlusion or even invagination phenomena leading to an operation. A correct diagnosis can generally only be made at the time of operation. Since intestinal duplica-

tions are generally operated on already at an early age, this disease must be regarded as a typical children's complaint. The oldest patient in the material of M. E. LADD and R. E. GROSS was 9, but there is also a description of a patient operated on at the age of 62.

The therapy consists of a careful removal of the duplication, as in our cases. Yet it is often technically impossible to do so without injury to the blood supply of the part of the intestine involved, and it then becomes necessary to remove the latter as well. C. E. GARDNER and O. HART had a case of a duodenum duplication, which they drained to the duodenum and left the tumour with good result. In some cases attempts were made to destroy the mucous membrane of the tumour by injecting into it some sclerosing substance. In addition, marsupialisation has been resorted to, when the tumour is attached to the abdominal wall, opened through this latter, and plugged with a tampon. This method is specially recommended by COGSWELL and THOMPSON in such cases where the general condition of the patient is poor and for children 1 to 2 years old.

W. E. LADD and R. E. GROSS write: "In the majority of cases the treatment of choice is resection of the duplication and its adjacent gut and the reestablishment of the intestinal continuity by a side-to-side anastomosis." Because of anatomic peculiarities of the duplication of the stomach and duodenum the resection appeared to be rather hazardous and hence was avoided by them. In such cases they recommend marsupialisation or a sufficiently extensive drainage into the alimentary tract. In our opinion, a surgical technique dictated by the circumstances is to be adapted in each case, but we feel that a resection of the adjacent gut of the duplication or of the stomach can often be easily avoided in such cases where the blood vessels in the alimentary canal cannot be spared, by confining oneself to a peeling-off of the mucous membrane in the opened duplication, instead of a radical extirpation. By peeling off the mucous membrane of the firmly adherent "basis" of the duplication an opening of the lumen of the intestine can most surely be prevented.

In spite of the relative rarity it would be well to bear in mind the possibility of duplications in laparotomies where one finds thickwalled cysts adhering to the alimentary tract.

With regard to the genesis of intestinal duplications several theories have been advanced. F. COLMERS thought they resulted

from rests of the ductus vitello-intestinalis. This hypothesis does not cover all the possibilities, since, as described above, the cysts can be localised in practically speaking any part of the intestinal canal. According to I. BROMAN, at least those cysts which are situated near the valvula ileocecalis can be regarded as pancreatic aberrations. F. T. LEWIS and F. W. THYNG observed that in the fetal state a great number of small diverticula occurs in the intestinal canal of both animals and humans, and particularly just in the ileocecal region. They assume that such a diverticulum becomes tied up and then develops into a duplication. This is indeed consistent with the usual site of the anomalies and with the fact that duplications often communicate with a larger or smaller opening into the intestine. On the other hand, this theory does not explain why one can see in duplications mucosa of the large intestine in the upper parts of the intestinal canal and, to the contrary, ventricular mucosa farther down.

The cases described by us above are in fact duplications typical in every respect, with a macroscopic as well as histological structure specifically characteristic. It is hardly possible on their basis to gain any definite idea of the genesis of duplications. Yet they do not seem to yield any support to BROMAN's theory, in this respect they differ far too much from the usual pancreatic structure; on the contrary, the microscopic picture fully reminds of the corresponding intestinal part, and therefore argues most in favour of the THYNG-LEWIS' theory.

Summary.

The present study includes a short review of duplications of the alimentary tract with a description of 2 cases of the authors: 1) girl aged 8 months. A cyst the size of a man's fist was removed from the cranial part of the colon transversum to which it was organically attached on an area of 3 times 4 cm, which made a sharp extirpation necessary. The recovery was uneventful. The cyst contained transparent fluid, the wall structure was that of the large intestine. 2) a girl aged 6 weeks who had a duplication containing oily fluid protruding into the anus. While removing it only the mucosa of the wall adherent to the rectum was peeled off. The recovery was normal. Microscopic examination revealed in the thick wall of the duplication a structure resembling that of the colon.

With regard to the operative technique the authors recommend a peeling-off of the mucous membrane in the duplication in all those cases where a radical extirpation is not possible without a resection of the adjacent intestine, and in order to prevent the opening of the lumen at the "basis" of the duplication.

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From the Neurosurgical Clinic of the Caroline Institute in
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Radical Removal of Arteriovenous Aneurysm in the Masseter Muscle.

By

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Arteriovenous aneurysms in the skeletal musculature are comparatively rare. JENKINS & DELANY (1) have collected 256 cases of these tumours, which mostly occur in patients in the first 3 decades of life, particularly in the muscles of the extremities. The authors do not give the figures of occurrence of these tumours in muscles of the face, but the number must be small. In the literature are described only a few cases of deeply situated angiomas of the face.

The greatest number of cases is collected by KÜTTNER (2), who describes 19 cases, which, however, were mostly parotid-, not muscular angiomas.

GARCIA (3) states, that these tumours are very rare. In his surgical material during 12 years, from about 6,000 operative cases, he has met with only one case of a deeply situated angioma of the face.

GULDBERG (4), BANCROFF, GARBER & CARR (5), FIGÉ (6) and CADENAT (7) also each describes only one case.

About the treatment of these tumours in the face there are different views.

GARCIA (3) says that the treatment of choice is operative. He describes a case of large angioma in the face, where at operation it was necessary to remove also the eye.

Also GARÉE & BORCHARD (8) advised surgical treatment and recommend ligation of all the afferent branches of the blood-

vessels. They say that it is sometimes even necessary to ligate the external carotid arteries on both sides. :

On the contrary FIGÉ (6) describes one case of deeply lying angioma in the face. He thinks that irradiation gives the best cosmetic results, and this is generally used in the Mayo clinic. He does not give the figures. Also GULDBERG (4) advises X-ray treatment. He says that these tumours are very adherent to the surrounding tissue and therefore surgical treatment is not successful. The difficulties of radical removal were pointed out also by BISHOP (9). Due to possible difficulties of removal in cases described by BANCROFF, GARBER & CARR (5) and CADENAT (7) attempts of treatment were not done.

On July 4th, 1939, a 32 years old patient was admitted to the Neurosurgical clinic of Serafimerlasarettet in Stockholm. He had from childhood a tumour on the left side of his face, which gradually became larger. For cosmetic reasons the patient wanted to get rid of the tumour.

General state of the patient was normal. On the left side of face the patient had a deeply situated tumour the size of goose egg. The tumour was strongly pulsating and a systolic murmur could be heard over it.

Arteriography (LYSHOLM) in the left external carotid artery showed a large conglomeration of wide blood vessels behind and above art. maxillaris externa. The external carotid artery was hypertrophic and wide.

At operation 12th of July 1939 (OLIVECRONA) it was found that the tumour was lying deep and medially to the left parotid gland. The skin incision extended from the lobule of left ear over the anterior border of the tumour to the left ala nasae. After reflection of the skin flap two facial nerve branches were identified. One, quite big one, going probably to the musc. orbicularis oculi, and one smaller going in the direction of the outer canthus of the eye were found. It was found that the aneurysm was lying medial to the parotid gland. The attachment of it to the zygoma was divided with preservation of the above mentioned facial nerve branches. After the upper part of parotid gland was separated from masseter muscle there was a bundle of blood-vessels between the size of a goose guill and that of a pencil, which were filled with arterial blood. The greatest part of the aneurysm was situated in the masseter muscle. It seemed that a muscular arterio-venous aneurysm was present.

The blood-vessel bundle was held with a forceps and gradually separated from the surrounding tissue. Gradually the afferent and efferent blood-vessels were ligated with ligatures and silverclips. By this procedure a part of the masseter muscle, which was infiltrated by aneurysm, was extirpated. At the operation a great part of the aneurysm was extirpated still leaving behind a part of it lying mostly postero-medially, which was not possible to reach due to the very narrow access.



At admission to the clinic.



Before 2nd operation.

After haemostasis was secured, the parotid gland was attached to the zygoma, and suture of skin followed.

The *pathological report* was: An intramuscular racemose angioma, which consists of blood-vessels with walls of irregular thickness.

After the operation a large swelling appeared in the area due to post-operative haematoma and the remaining part of tumour. The patient left the clinic with the tumour unchanged.

There was no decrease in the size of the tumour during the next four years, and therefore on the 11th of December 1943 the patient came to the clinic for a second operation.

On 16th of December 1943 OLIVECRONA performed the radical removal of tumour under local anesthesia.

The incision extended along the posterior border of the body and vertical ramus of the left mandible. Another incision was made below the lobule of the ear in a posterior direction extending backward about one and half inches and joining the main incision, for the exposure of the preparotid part of facial nerve. The facial nerve was identified. It appeared to be thinner than normal. The identification was confirmed by faradic stimulation. After the exposure of the postero-medial lobe of parotid gland, which was unusually large, the original route of access to the tumour was chosen.

One more auxiliary incision was made in the direction of the incision which had been made at the first operation. After this all the skin incisions showed a cross-shaped figure. Skin flaps were raised and the lateral surface and antero-medial border of the parotid gland was exposed. Along the anterior border of it two big facial branches were found. The faradic stimulation showed that these branches innervated the muscles attached to the angle of mouth.

Incision into the parotid gland was made about in the same place as at the first operation. A large arterialized vein was cut and severe bleeding followed. This was stopped by use of artery forceps. To gain

access to the tumour the parotid gland was mobilized anteriorly and from below. After that a bundle, of about the size of a small orange (mandarine), of arterialized veins was exposed. It was lying between the parotid gland and the masseter muscle. The bigger part of the bundle infiltrated the masseter muscle. A large arterialized vein was ligated, which emptied into the facial vein. This last vein was the size of the little finger. After gradual ligation of afferent and efferent branches to and from the aneurysm, it was mobilized. By this procedure part of the masseter muscle was sacrificed.



3 years after second operation.

The aneurysm extended also into the pterygo-palatine fossa. After as much of the aneurysm as possible had been removed, it seemed, that a piece of tumour the size of the terminal portion of the thumb remained in the pterygo-palatine fossa.

The main afferent branches to the tumour coming from the internal maxillary artery were ligated. They were of size of a goose quill and tortuous. There were no arteries coming from behind the pterygo-palatine fossa, but only few large arterialized veins running out of the aneurysm, which were ligated.

In spite of perfect haemostasis a tampon was left in the defect. Beside the tampon a rubber drain was left at the closure of wound.

The response of musculature innervated by facial nerve branches on the faradic stimulation remained during all the operation, which lasted 5 hours. On the contrary voluntary movements of these muscles disappeared and a complete facial nerve paralysis was present at the end of operation.

The facial nerve paralysis recovered completely within a few months. At present the patient is free from recurrence.

The case illustrated that for the deeply lying angiomas in the face, which are cosmetically very disfiguring, the treatment of

choice is surgical. With good operative technique, using all precautions to spare the branches of the facial nerve, radical removal gives the best cosmetic results.

Summary.

Description of radical removal of an arteriovenous aneurysm located deeply in the masseter muscle on the left side of the face in a 32-year-old patient. Operation was performed in two stages, in July 1939 a partial removal of the tumour was done, and in December 1943 at the second operation the radical removal of the tumour followed. The details of operation are given in the paper.

The case is rare, and in the available literature one could not find a similar case where a deeply situated tumour behind the parotid gland was removed with complete saving of facial nerve functions.

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Bronchiogenic Carcinoma.

By

KAARE LIAVAAG.

The first thorough description of bronchiogenic carcinoma is given by ADLER in a monography in 1912. He could only collect 374 cases from the literature. As a contrast to this it may be mentioned that the incidence of bronchiogenic carcinoma today allegedly equals that of cancer of the colon, and some authors, *e. g.* OCHSNER and DEBAKEY maintain that it rates among cancer of the stomach which is the commonest form of cancer in the intestinal tract. This they conclude on the basis of figures from the Charity Hospital, New Orleans, which is a large state hospital, the patients of which no doubt represent a rather typical average of the population in an American state. Whether this increased incidence of bronchiogenic carcinoma is real or whether it is to be attributed to improved diagnostic methods is difficult to ascertain. Most authors think that both factors are involved.

At our department a total of 80 cases of bronchiogenic carcinoma have been treated during the period extending from 1936 to May 1st 1948. The task of revising this material has been deferred to the author by the head of the department, professor JOHAN HOLST. Table 1 shows the distribution according to various years.

It appears that only scattered cases occurred during the first years. From 1944 there is an even increase the highest incidence being in 1947 with 23 cases. However, this cannot just be regarded as an actually increased incidence, but must be seen in relation

Table 1.

Incidence of Bronchiogenic Carcinoma, 1936—1948.

Year	Number of Cases	Operation Performed	Postoperative Deaths
1936—1940.....	8	4	2
1941.....	5	3	0
1942.....	1	0	
1943.....	4	1	0
1944.....	9	3	3
1945.....	7	1	0
1946.....	18	3	2
1947.....	23	4	0
1948 (4 months)	5	2	0
Total	80	21	7

to the increasing number of cases being admitted to surgical wards owing to the possibility of radical surgery which now exist.

Sex Incidence.

Like carcinoma of the esophagus and carcinoma of the larynx bronchiogenic carcinoma is far more common in males than in females. However, the distribution according to sex varies considerably in various statistics. Comparing the figures published by HARNETT, TINNEY, DAVIDSON, PARNELL, RIENHOFF, POHLE and SIRIS, BJÖRKMANN, BJÖRK, WATSON and URBAN, FARBEROW and BASLOW the ratio males/females varies from 4 to 1 in Harnetts material (1,063 cases) to 13.5 to 1 in Farberow and Baslows material (130 cases). If all these figures are assembled into one large group we have 2,734 cases with a sex distribution of 6.1 males to one female.

Our material consists of 53 males and 27 females, *i. e.* a considerably lower preponderance of male incidence than in any of the reported materials. However the number of cases verified by biopsy are comparatively smaller for females as compared to male, viz. 18 of 27 females against 43 of 53 males, respectively. Even if only the cases verified by biopsy are considered there are 43 males against 18 females. The material is of course comparatively limited, but attention ought to be paid to this circumstance in the future because experience has shown that as in the case of other forms of cancer, the sex incidence of the very same form of cancer may show considerable racial and geographic variations.

Age Incidence.

Bronchial carcinoma is stated to be a rare occurrence below the age of 40. However, no definite lower age limit for bronchiogenic carcinoma exists. Several cases occurring in early infancy have been described (HAUSER, FIELD and QUILLIAM).

The age incidence in our material is shown in table 2.

Table 2.

Distribution According to Age.

Age	Number of Cases
15—20.....	1
21—30.....	2
31—40.....	8
41—50.....	24
51—60.....	29
61—70.....	15
71—80.....	1

Average age for males: 51½ years

Average age for females: 50½ years

Average age for the total material: 51¼ years

The youngest case in this material, a 19 years old girl, had an "oat cell" carcinoma. In the age group from 21 to 40 years there were two cases, and in that from 31 to 40 years 8 cases. 69 cases, *i. e.* 86 % are over 40 years of age. This conforms with other statistics. However 14 % occurred in younger age groups, so the disease should be borne in mind also in patients under the age of 40 in the presence of suspicious symptoms from the respiratory tract. The highest number of cases in our as in other materials occurred in the age group from 51 to 60 years. The average age is 51 years. Several authors maintain that as regards females there is a displacement to the younger age groups. This is not so in our material. The average age for females is a little below 51 years, for males a little more than 51 years.

Pathology.

A brief mention of the patho-anatomical picture is necessary for an introduction to the symptomatology. The term primary carcinoma of the lung is now usually confined to bronchiogenic carcinoma because it has been established that the peripheral as

well as central tumors always arise from bronchial epithelium. The gross appearance may be most varied. The most common finding is a grayish-white tumor in the region of the hilus usually showing to a main bronchus. It may project into the lumen as a papillary mass which may block the bronchus. But it may merely cause a white fibrous thickening of the bronchial wall with narrowing of the lumen and only a suggestion of roughening of the mucosa. In a relatively small number of cases the tumor arises in the peripheral part of the lung and must then be considered as arising from a small bronchus. Such tumors tend to be more circumscribed. It is emphasized, though, that the term peripheral means that the tumor is situated peripherally in a lobe. If the tumor therefore is situated close to another lobe, it may appear centrally in the roentgenogram, and situated towards the mediastinum it may impose as a mediastinal tumor.

A grouping has been attempted according to the part of the lung from which the tumor arises. Such a grouping has, however, been very difficult. A tumor arising from a segmental bronchus may, when the condition is diagnosed, have spread to a lobar bronchus. BJÖRK has made the classification according to the proximal spread when the diagnosis was made. He distinguishes between three groups:

- 1) Central tumors located to main or lobar bronchi.
- 2) Intermediate tumors located to a segmental bronchus.
- 3) Peripheral tumors.

Thus he has found central tumors in 65 %, intermediate tumors in 22 % and peripheral tumors in 12 %.

In the material here presented a similar grouping has been made. The result is shown in table 3.

As it appears, the intermediate group is smaller in our material than in that reported by BJÖRK. This may be attributed to the condition being diagnosed at a later stage when the tumors had spread proximally. However the distinction between central and intermediate tumors is not distinct, and if the two groups are considered as a whole, the incidence is the same in both materials.

The table also shows that there is a right side preponderance. The same has been found by TINNEY and BJÖRKMANN, whereas BJÖRK found no side preponderance. The reason for the higher right side incidence is partly due to the right lung being larger than the left. Further the upper lobe incidence is higher than the lower lobe incidence. The same has been found in most materials.

Table 3.

Location.

	Total	Central Tumors	Intermediate Tumors	Pheripheral Tumors	Non-classifiable
Right upper lobe	17	10	2	4	1
Right middle lobe	4	2	1	1	
Right lower lobe	18	14	2		2
Right side, lobe not stated	9	5		2	2
Right side, total	48	31	5	7	5
Left upper lobe	19	12	3	3	1
Left lower lobe	6	4	1	1	
Left side, lobe not stated	7	6			1
Left side, total	32	22	4	4	2
Total	80	53	9	11	7
Upper lobe			36		
Middle lobe			4		
Lower lobe			24		
Lobe not stated			16		

Björkmann found a preponderance of the right upper lobe incidence, Björk of the left. In our material both lobes were about equally represented. But when there is still a right side preponderance this is due to a considerable higher right lower lobe incidence as compared to the left, besides the tumors occurring in the middle lobe.

The microscopic picture is most varied. Three histological groups are usually distinguished:

1) Anaplastic or undifferentiated tumors, the cells of which may be small round cells, spindle-shaped, or more oval. The small "oat cell" type is usually distinguished as a special group. All these types has often been regarded as sarcoma.

2) Andenocarcinoma.

3) Squamous-cell carcinoma.

As a special group is distinguished the bronchial adenoma or mixed tumors of the salivary glands, which are regarded as clinically innocent although potentially malignant.

In our material biopsy has been performed in 61 cases. In 36 cases the biopsy material was obtained by bronchoscopy (in several of these cases additional biopsy material was obtained during radical operation, exploratory thoracotomy or autopsy). Biopsy material in the rest of the cases has been obtained partly by thoracotomy and partly by autopsy. Furthermore, biopsy

material was obtained in 2 cases by removal of a cervical lymph node, and in two cases needle biopsy was used. There is much disagreement as to whether needle biopsy is justifiable. The method can only be considered in those cases presenting a roentgenologically well defined tumor. Some authors regard the method as harmless. However, transient symptoms of air embolism have been described, and also implantation of tumor cells along the needle track (DOLLEY and JONES). Several thoracic surgeons, *e. g.* OVERHOLT, OCHSNER, ADAMS and GRAHAM are strongly against the use of needle biopsy. They maintain that except in definitely inoperable cases these tumors always indicate thoracotomy, because a negative needle biopsy never excludes the presence of a malignant tumor. They think, therefore, that the patient should not be exposed to the risk of unnecessary spread or other complications.

The patho-anatomical distribution in our material is shown in table 4.

Table 4.
Histological Classification.

	Males	Females	Total
Squamous-cell carcinoma	20	2	22
Anaplastic carcinoma	14	9	23
Adenocarcinoma	9	7	16
Total	43	18	61

One adenocarcinoma arose from an adenoma which underwent malignant transformation. Pure adenoma, however, are not included in this material.

Such a classification is, however, very difficult. A tumor which by one pathologist would be described as slightly differentiated might by another be described as an adenocarcinoma on the basis of isolated areas of alveolar grouping of the cells. The incidence rate of the various forms thus also varies according to various authors, but the squamous cell carcinoma is usually stated to be the commonest. However the incidence rate varies from 58 % (BRINDLEY) and 22 % (DOBBIE). As regards adenocarcinoma the figures vary from 40 % (BRINDLEY) to 8 % (BJÖRKMANN), and the incidence of undifferentiated carcinoma from 70 % (DOBBIE) to 19 % (TENZEL). If the figures given by BRINDLEY, TENZEL, BJÖRK, RIENHOFF, GRAVER, BJÖRKMANN and HILTON are considered as a whole we have 1,118 cases distributed as follows: Squamous-cell carcinoma 50 %, undifferentiated 26 %

and adenocarcinoma 24 %. As shown in the table there is a comparatively low incidence of squamous-cell carcinoma in our material. This may possibly be due to the large number of females in our material, as it is usually stated that squamous-cell carcinoma seldom occurs in females. As shown in the table there were only two cases of squamous-cell carcinoma among the female patients. BJÖRK, however, in the material from Bromton Hospital found the same incidence of squamous-cell carcinoma in males as in females.

It is stated that the undifferentiated forms are usually confined to younger age groups as compared to the other forms. In our material there is an even distribution in all age groups. The youngest patient, however, had "oat cell" carcinoma. BJÖRK, in the large material from Bromton Hospital, was not able to find any relation between age and differentiation. Furthermore, he found no relation between histological type and location, and the lesions appearing as well defined tumors showed the same distribution according to histological type as the other forms. In our material, among the 11 cases presenting the picture of a peripheral well defined tumor, there was a preponderance of adenocarcinoma, viz. 6 cases, as compared to 2 cases of undifferentiated carcinoma and 1 case of squamous-cell carcinoma, no biopsy being performed in the remaining two cases.

Symptoms.

Most of the symptoms of bronchiogenic carcinoma are related to associated inflammatory changes of the bronchial mucosa and secondary complications such as bronchiectasis, atelectasis, abscess and empyema. The only initial symptoms which is actually related to the tumor is the hemorrhage. The symptoms usually encountered are shown in table 5.

Table 5.

Symptoms.

	Cases
Cough	69
Lassitude, loss of weight	59
Dyspnea	43
Blood-tinged sputum	42
Pain	38
Intrathoracic infection	34
Hoarseness	6

This table is based partly on the symptoms of the patient upon admission and partly on the history. Cough is the main symptom and occurred in 69 cases, *i. e.* 86 %. This incidence corresponds to the figures found by OVERHOLT, BJÖRKMANN, TINNEY and RIENHOFF.

Most of our patients had in the initial stage of the disease persistent dry cough. Later on during the disease the cough became productive owing to secondary pulmonary changes caused by the stenosis.

Lassitude and loss of weight occurred in 59 cases, and were thus a rather marked feature. A real loss of weight, however, occurred only in a minor number of these cases, whereas most of them complained of lassitude.

Dyspnea occurred in 43 cases, *i. e.*, in about 55 %. The dyspnea which occurs in bronchiogenic carcinoma may have several causes. It may be caused by occlusion of a bronchus so that the corresponding part of the lung or a whole lobe is rendered airless. Further it may be due to an exudate. In some cases there may be a marked dyspnea although the volume of the lung is but very slightly reduced. It is possible that this is due to pressure on the vagus nerve (HERING and BREUER).

Hemorrhagic sputum was found in 42 cases, *i. e.* in about 50 %. The hemorrhage may take the appearance of streaks of blood in the expectorate, or a teaspoon or tablespoon of fresh blood may be raised. Occasionally there may be profuse hemoptysis. In this connection it should be emphasized that a scanty blood-tinged sputum is perhaps a more important symptom than a profuse hemoptysis where cancer of the lung is concerned.

Pain occurred in 38 cases *i. e.* in about 45 %. Various mechanisms may be involved regarding the pain in bronchiogenic carcinoma. A comparatively acute pain which is accentuated by deep inspiration is usually due to atelectasis, which is probably the commonest cause of pain in bronchiogenic carcinoma. Other causes of pain are due to the tumor infiltrating the parietal pleura or the thorax wall and intercostal nerves, or brachial plexus.

Signs of intrathoracic infection occurred in 34 cases, *i. e.* in about 40 %. This infection is the result of the obstruction caused by primary tumor, which gives rise to secondary infection leading to secondary pneumonia, bronchiectasis, abscess or empyema, which may dominate the clinical picture and mask the primary lesion. Several of the patients had before admission been treated

for unresolved pneumonia, recurrent pneumonia or recurrent influenza-like conditions. Several cases had also been interpreted as chemoresistant pneumonia. In 8 cases the condition for a shorter or longer period had been erroneously diagnosed as pulmonary tuberculosis despite the fact that tubercle bacilli could not be demonstrated. In a few cases artificial pneumothorax and phreniclasia had even been instituted. In one case drainage was instituted for secondary empyema. In two cases a secondary abscess of the lung was not recognized as related to a bronchiogenic carcinoma, and pulmotomy was performed. In one of these cases tumor tissue was found in the wall of the abscess at the operation. In the other case the tumor was found at autopsy. It is emphasized, therefore, that pulmonary abscess is such a common complication of bronchiogenic carcinoma, that in all cases of pulmonary abscess bronchoscopy should be performed, and biopsy should always be taken from the wall of the abscess during the operation.

Hoarseness was present in 6 patients. In 5 cases it was due to paresis of the recurrent nerve, caused by carcinomatous infiltration, rendering the case inoperable. In the remaining case the nerve was not involved and the tumor was operable.

The symptoms mentioned above may occur at any stage of bronchiogenic carcinoma, except for hoarseness which often, but not always, is a sign of infiltration of the recurrent nerve and thus indicates inoperability.

The incidence of the various symptoms as shown in the table represents the symptoms as they occur at a comparatively late stage in the disease, as a large number of cases are inoperable. What is of far greater practical importance are the symptoms of the initial stage of the disease. The first symptom as it occurred in our material is shown in table 6.

This table shows that cough is not only the commonest symptom in the entire material, but that it predominates as an initial symptom occurring in 57 %. The same per cent is found by BJÖRK. The cough may be of the types described above, and in this connection it is emphasized that a persistent dry cough of more than 3 months duration in patients over the age of 40 should always arouse suspicion of bronchiogenic carcinoma, and roentgenographic examination as well as bronchoscopy should be performed.

The other symptoms are rare as a first symptom compared

Table 6.

First Symptom.

	Cases
Cough	46
Lassitude	8
Dyspnea	7
Pain	6
Infection	5
Hemoptysis	4
Metastases to the brain	1
Superior vena cava obstruction	1
No symptoms, condition accidentally detected	1

with the cough. Dyspnea, pain, lassitude, and infection are equally frequent. Remarkable is the minor part played here by hemoptysis, which in this material was the first symptom in 4 cases only, *i. e.* in 5 %. In one case cerebral metastasis was the first symptom, in one case paresis of the recurrent nerve, and in one case superior vena cava obstruction.

In one instance the disease had not produced symptoms but was detected accidentally. Otherwise the material contains 5 other cases where the disease was accidentally detected, upon mass X-ray examination, but these cases have been included in one of the above mentioned groups, because the condition being misinterpreted as other lesions until clinical symptoms appeared.

The symptoms which took our patients to the doctor are not recorded in all our cases. BJÖRK found that hemoptysis brought the patient to the doctor in 30 %, pain in 25 % and infection in 12 %. In 7.5 % only it was the cough which made the patient seek medical advice. This is rather surprising in view of the fact that cough is the first symptom in 57 % of the cases. Another question which arises here is the duration of symptoms when the doctor is consulted, and when the condition is diagnosed. It is a well known fact that the disease is often not diagnosed until far advanced so that the case is inoperable. The responsibility for this late diagnosis is partly due to the patient, who delays visiting the doctor, and partly to the doctor not considering the possibility of bronchiogenic carcinoma and thus not carrying out the necessary special examination. By knowing the date upon which the doctor was consulted the first time it is possible to ascertain how much of the late diagnosis can be blamed on the patient or the doctor. BJÖRK, in 112 inoperable cases of bronchio-

genic carcinoma found an average duration of symptoms of 8.4 months. The average duration before a doctor was consulted was 3.4 months. This is to be blamed on the patient, whereas 5 months are to be blamed on the doctor. In 70 of our cases the time at which symptoms appeared can be approximately determined. The average duration after history has been 8.5 months, whereas only an average of 2 months has elapsed before a doctor was consulted. This means that in our material the doctor was responsible for a delay of 6.5 months. It shows that the Norwegian patients on an average seek medical advice earlier than the British, and we have also the impression that it is not alarming symptoms such as hemoptysis that take the patient to the doctor. In this country, therefore, it ought to be possible to diagnose these cases at an earlier stage if the doctors would just be more "cancer-minded" in regard to symptoms from the respiratory tract. This does not merely apply to the common practitioner. In our material specialists in tuberculosis, internal medicine, roentgenology, surgery and our own clinic were also responsible for the delay. However, even if the disease can be diagnosed at a considerably earlier stage a considerable number of cases will be inoperable. Thus it is remarkable, that in Björks material including 112 cases of inoperable cancer, the duration of the disease was less than 3 months in 35 %. As mentioned, the average duration in our material was 8.5 months. If we calculate the average duration of symptoms in the operable, or rather the cases operated upon, the duration is the same, *i. e.* 8.5 months. Several of the cases, however, were operated upon at such a late stage that spread had occurred to the mediastinum. The average duration of symptoms in the cases not presenting metastases was 7 months as against 10.5 months in the cases where metastases were present. This illustrates the significance of immediate operation in diagnosed cases, as only a short delay may render the tumor inoperable. When the diagnosis has been made there is, from a surgical point of view, urgent need for immediate action.

The sedimentation rate was determined in 75 patients. As an average it was increased (55 mm) but varied within wide limits. It should be noted, however, that in 4 cases only the sedimentation rate was less than 10 mm, whereas in 9 cases the sedimentation rate was more than 100 mm. However, this high sedimentation rate is often due to complicating intrathoracic infections.

Diagnosis.

At the initial stage of the disease physical examination often will be negative. The physical findings alone are never conclusive, but must be supported by roentgen examination and bronchoscopy. If neither of these examinations is conclusive an exploratory thoracotomy is usually indicated.

Roentgenographic Findings.

The roentgenographic findings differ in peripheral and intermediate and central tumors. Peripheral tumors of the lung are usually sharply circumscribed. If the tumor is situated towards the mediastinum, it is therefore in many cases difficult to make the differential diagnosis towards benign and malignant tumors in the mediastinum, even if planigraphy, bronchography, artificial pneumothorax and thoracoscopy are employed. In 11 cases of peripheral tumor in our material the tumor in all instances was sharply circumscribed. In 3 of these cases the tumor was situated towards the mediastinum and roentgenologically simulated a mediastinal tumor. In one instance the central part of the tumor was necrotic.

In the central and intermediate types the atelectasis, owing to the bronchial obstruction, is the essential roentgenographic feature. The atelectasis is usually complicated with secondary pneumonitis so that there is a combination of atelectasis and pneumonitis. These cases have, therefore, been grouped together as atelectasis. Atelectasis thus occurred in 55 cases, *i. e.* in 70 %. Total atelectasis was present in 5 cases, lobar in 37 and segmental in 13 cases. BJÖRK found a somewhat larger incidence of segmental atelectasis. This complies with the fact that he found a higher incidence of the intermediate types in his material.

Pleural effusion was present in 14 cases. In 3 of these cases the exudate was blood-stained. In 5 cases necrosis had occurred in the atelectatic area peripherally to the tumor so that the condition imposed as a lung abscess. Minor abscesses, however, are indubitably a far more common complication. In one case distant spread had occurred to the other lung. In 2 cases the dome of the diaphragm was elevated owing to infiltration of the phrenic nerve. In 14 cases the tumor was circumscribed, and in 11 of these

cases it was situated peripherally. In all the cases positive roentgenographic findings were obtained. It must be emphasized, however, that normal roentgenograms do not exclude the presence of bronchiogenic carcinoma. In Björks material 6.5 % of the cases presented normal roentgenograms, and Norris found 2 %. If therefore there is the slightest suspicion of bronchiogenic carcinoma, it is necessary to perform a bronchoscopy, even if the roentgenograms are entirely negative.

Regarding the usefulness of supplementary diagnostic means such as planigraphy and bronchography there is some controversy. Some consider them as of definite value as they may only reveal the presence of a stenosis, even if the nature of the stenosis is not revealed. Moreover, it is always necessary to perform a bronchoscopy, and the nature of the stenosis may then be determined by a biopsy. Other authors consider the methods just mentioned as most useful. Our own view in this matter will be given later.

In the case of a peripheral apparently circumscribed tumor a planigraphy or bronchography may give valuable information as to whether the tumor is situated within or outside the lung, and a planigraphy may reveal the presence of central necrosis. Peripheral tumors in our material had in no instance given rise to bronchial occlusion, although compression or dislocation of bronchi was revealed in a few cases.

In the 69 cases of central and intermediate tumors planigraphy was performed in 35 cases and bronchography in 22 cases. In 10 cases both methods were used. In 33 of the 35 cases the planigraphy revealed bronchostenosis. In 2 cases the result of the examination was negative. Bronchography in all 22 cases revealed bronchostenosis. In 32 of these 47 cases biopsy material was obtained by bronchoscopy. The planigraphy and bronchography thus revealed bronchial obstruction in 13 cases where biopsy was feasible. As will be shown below, most of these tumors occurred in the upper lobes in which cases most difficulties are involved in obtaining biopsy material. The roentgenogram, however, is often inconclusive regarding the character of the stenosis. In two instances we have performed pneumonectomy where a chronic non-specific inflammation had been erroneously diagnosed as a bronchiogenic carcinoma on the basis of a bronchial stenosis revealed on the roentgenogram. In both these cases the process was situated in the upper lobe. We have found, however, the planigraphy and bronchography very useful, but it is emphasized

that a bronchoscopy should be carried out in all cases where a bronchial stenosis appears in the roentgenogram as the roentgenogram is in conclusive regarding the character of the stenosis. We suggest the following procedure: An ordinary chest roentgenogram is first taken. Even if this examination leads to the goal, a planigraphy or a bronchography should be performed as these investigations may give valuable informations regarding the spread of the tumor. Which of the two latter methods is to be used is a matter of opinion. A bronchography, even when the most perfect technic can be observed, always involves the risk of contrast medium being retained in the lungs where it may give rise to atelectasis. At the Rikshospitalet in Oslo we have, therefore, adopted more and more the use of planigraphy. As shown by FRIMANN DAHL and MARSTRANDER the planigraphy is as valuable as the bronchography. Another advantage of the planigraphy is that it may reveal the tumor shadow more exactly.

Mediastinal angiography has only occasionally been used in an attempt to determine whether the tumor is operable or not.

Bronchoscopic Findings.

The most important examination in bronchiogenic carcinoma is the bronchoscopy. Here the bronchoscope is as important as the cystoscope is to the urologist. Bronchoscopy was performed in 67 cases. It is once more emphasized that bronchoscopy now is performed in all cases, whereas this previously was not done. The result is shown in table 7.

Table 7.
Bronchoscopy.

	Cases
Tumor seen, biopsy taken, section positive	34
Tumor seen, biopsy not taken, or section negative	5
Tumor not seen but biopsy taken at random, section positive	2
Compression of bronehus or trachea	12
Bronehosecopy normal	14
	<hr/> Total 67

The table shows that the biopsy was positive in 36 cases, *i. e.* in 54 %. If we also include the 5 cases where the tumor could be seen but where biopsy was not taken or was negative, there is

thus 41 cases *i. e.* 60 %. The figures for positive biopsy vary in the literature from 50 to 75 %.

The distribution to the respective lobes is shown in table 8.

Table 8.

The Relation of Location to Bronchoscopic Findings.

	Number of Cases	Positive Findings	Norris's Material
Right upper lobe	13	6	58.7 %
Right middle lobe	2	1	57.0 "
Right lower lobe	16	12	88.6 "
Right main bronchus	7	7	100.0 "
Right side, lobe not stated	2	0	
Left upper lobe	16	5	32.6 "
Left lower lobe	5	4	86.4 "
Left main bronchus	6	6	100.0 "
Left side, lobe not stated	1	0	

Our figures correspond with those published by NORRIS based on 310 cases as indicated in the table. Both materials show that it is the upper lobe bronchus, particularly the left, where the main difficulties are involved in taking a biopsy, only 32 % positive biopsies being obtained. In the main bronchus the biopsy was positive in 100 %. Biopsy from the lower lobe bronchus in Norris's material was positive in more than 80 %. In our material the corresponding figures are somewhat lower, the percentage being 75 and 80 % for the right and left side, respectively.

Examination of sputum for tumor cells has not till recently been employed as a routine method in our clinic. Several authors (BARRET, DUDGEON, COWER and WANDALL) have reported a relatively high incidence of positive findings by cytologic methods. It must be emphasized, however, that in many of the cases where neoplastic cells appear in the sputum it is possible to do a biopsy by bronchoscopy.

In two cases the diagnosis was made by needle biopsy. Regarding the indications and contraindications for this method, reference is made to the paragraph dealing with the pathologic anatomy.

Treatment: The only effective treatment for bronchiogenic carcinoma is pneumonectomy (in some instances lobectomy). Many surgeons are of the opinion that lobectomy has no place in the treatment of bronchiogenic carcinoma. Others maintain that lobectomy should be performed in the circumscribed and peripherally invasive groups in cases without node involvement.

There is, however, no way by which the surgeon, in the course of the operation, can tell, whether or not the lymph nodes are involved with cancer. It is, therefore, our opinion that pneumonectomy should be the routine method except probably in patients in the older age groups. Pneumonectomy is a much more crippling operation than a lobectomy. Following a pneumonectomy the old patients often will be "chest cripples", whereas after a lobectomy most patients retain a good vital capacity. In patients in the older age groups, therefore, a lobectomy can be performed in selected cases.

To form an opinion as to how many of all bronchiogenic carcinoma cases are operable is difficult on the basis of the figures appearing in the literature. Most of the cases referred to a surgical ward for a possible surgical treatment represent selected cases, as some cases have already been ruled out as inoperable. When the operability is stated to 20 to 25 %, therefore, these figures are probably too high. These are the figures stated by WATSON and URBAN, OVERHOLT, GRAHAM, CRAFOORD. BJÖRK found that of 345 cases of bronchiogenic carcinoma referred to Brompton Hospital for surgical treatment 25.5 % were operable. When, however, all cases with the clinical diagnosis of bronchiogenic carcinoma (in both Medical and Surgical Departments) were included, only 7.5 % were operable. In our material the operability has been 25 %. This material, however, no doubt represents a certain selection.

Operation should be performed in all cases in which there are not definite contraindications. A considerable number of cases will, though, during the operation be revealed as inoperable, in most materials approx. 50 %. The incidence of inoperable cases in our material is shown in table 9.

Table 9.

Clinically inoperable, or operation refused by the patient	36 cases
Exploratory thoracotomy	23 »
Operation performed	21 »

The contraindications in our cases were: Poor general condition, metastases, mediastinal invasion, invasion of the growth too close to the carina, pleural effusion, paresis of the recurrent nerve, paresis of the phrenic nerve, invasion of ribs. Several of the patients presented a combination of these contraindications, for which reason no grouping has been attempted.

Old age in itself is no contraindication. But old patients *i. e.*, patients of 60 years of age or more, have usually such a small respiratory reserve that the operation involves a serious risk. Of the patients in our material who underwent a radical operation, 2 were over the age of 60. One of these died as the result of the operation. As mentioned above a lobectomy may probably be performed in these patients.

Extrathoracic metastases or metastases in the other lung, as in one of our cases are regarded as absolute contraindication.

Invasion of the tumor to close to the carina made the operation impossible in 6 cases, and widening or fixation of the carina in 10 cases. Whether the tumor as seen on bronchoscopy can be regarded as operable or not depends on how close to the carina the tumor is situated and whether there is fixation or signs of widening of the carina. Widening of the carina is regarded as a contraindication and is due to infiltration of lymph nodes in the bifurcation.

However, this is not an absolute contraindication. Cases with widening of the carina have been reported, where it has been possible to perform a pneumonectomy and resection of the regional lymph nodes. Such an operation can only be regarded as palliative. It must be considered justifiable, however, because the patients remaining span of life is more comfortable, and the figures presented by OCHSNER indicate that the average survival period probably is increased. In the last months, therefore, we have not regarded widening of the carina as an absolute contraindication.

In 3 cases there was a blood-stained pleural exudate. This has been regarded as an absolute contraindication, because such an exudate is due to invasion of the pleura or pleural metastases. A serous exudate is no contraindication to surgery. The exudate may be due to secondary infection of the lung, or merely atelectasis, in which case it may be transient.

Paresis of the recurrent nerve was the contraindication in 3 cases. In one case an exploratory thoracotomy was performed despite the paresis of the recurrent nerve. The tumor was operable. In one case the paresis occurred following the thoracotomy.

Paresis of the phrenic nerve combined with poor general condition was considered as contraindication in two cases. Tumor invasion of the sternum, vertebrae, or several ribs are contra-

indications, whereas invasion of one or two ribs is not an absolute contraindication if these ribs can be removed in one piece with the tumor. COLMAR has reported 5 such cases of which one was still alive after 6 years.

The first successful pneumonectomy was performed by GRAHAM in 1933. In Norway the first successful operation was performed by J. HOLST in a patient with a benign bronchial stenosis in 1937. The first successful pneumonectomy for bronchiogenic carcinoma was performed by J. HOLST in 1940. During recent years an increasing number of pneumonectomies have been performed. A fairly standardized technic has been adopted and the mortality rate has thus been reduced to a reasonable level. At our department 20 pneumonectomies and one lobectomy have been performed for bronchiogenic carcinoma. The first pneumonectomy and the lobectomy were performed by the tourniquet method. In the remaining cases the dissection method with individual ligation of the bronchus and vessels has been used. The bronchial stump has been closed by the technic described by J. HOLST. The stump is sutured with one continuous linen suture, buried in the mediastinum and covered by mediastinal pleura or pleural or pericardial flaps.

The first operations were performed with the patient under usual ether anesthesia without the use of a tracheal tube. Intra-tracheal anesthesia and controlled respiration is now used.

The postoperative mortality rate in the materials published by BRINDLEY, BJÖRK, GRAHAM, RIENHOFF and CRAFOORD varies from 21 to 40 %. None of these materials, nor ours, are representative as to the present operative mortality. They include several cases from a time when the operative technic as well as anesthesia were poorly developed, or in their experimental stages as compared with modern methods. The present operative mortality is stated to be from 10 to 15 % (BROCK, RIENHOFF). GRAHAM, however, had 2 deaths in his last 32 cases, OCHSNER in his last 30 cases had 2 deaths, JONES 2 deaths in his last 42 cases, and ADAMS one death in 30 cases, *i. e.* a mortality rate from 6 to 4 %. A similar improvement is seen also in our material. There are 7 operative or postoperative deaths (33 %). The two patients who were operated upon by the tourniquet method both died. In the 19 cases where the dissection technic was used we had 5 deaths (26 %). However, there has been an even decrease in the mortality rate and among the 6 cases operated during the year 1947 and the four first months of 1948 no operative deaths occurred.

The cause of death has been as follows: The two cases operated upon by the tourniquet method died 16 and 21 days, respectively, after the operation, both as the result of infection.

By the dissection method the 5 postoperative deaths were due to the following causes: 1 died from hemorrhage during the operation owing to a lesion of the pulmonary artery. 1 died of shock at the end of the operation. 1 died from atelectasis displaying signs of cardio-respiratory failure 24 hours after the operation. 1 died suddenly 4 days after the operation. At the autopsy emboli were found in the pulmonary artery of the other side. 1 died from complicating empyema (bronchial fistula) 6 weeks after the operation.

Postoperative complications: The complication which threatens these patients during the first postoperative days is atelectasis and bronchopneumonia in the remaining lung. The removal of one lung causes such an impairment of the respiratory reserve that even a slight atelectasis in the remaining lung may be fatal to the patient. It is, therefore, of utmost importance to ensure that the upper respiratory passages are free from secretion during the first postoperative days, if necessary by means of suction through a bronchoscope. In the patient who died of cardio-respiratory failure autopsy revealed atelectasis of the remaining lung.

Later on during the postoperative course a bronchial fistula with complicating empyema is the most important complication.

In 11 of the patients who survived the operation the postoperative course was essentially uneventful. The usual postoperative effusion has been aspirated two to three times according to the position of the mediastinum. In these cases no sign of infection of the exudate has been observed, a fact which indicates that bronchial fistula has not been present. Some of the patients, particularly the elder ones, have had some dyspnea during the first postoperative days so that administration of oxygen has been necessary. Extensive atelectasis has not been observed.

As mentioned, one patient died from bronchial fistula. Among the surviving patients there are a further two cases who developed an empyema. In one of the cases intercostal drainage caused the infection. That is the only case in the material which has been primarily drained. In all the other cases the wound has been closed without drainage. In the other patient the empyema must be attributed to a bronchial fistula. Further, we had one patient

who presented transient symptoms of a bronchial fistula, as he had profuse expectoration of serosanguinous fluid. Drainage was not instituted, but large doses of penicillin were applied into the thoracic cavity. The exudate remained sterile and the fistula healed. All cases of empyema occurred before the introduction of penicillin. It seems probable that routine intrathoracic application of penicillin during the postoperative course may minimize the incidence of empyema.

One patient developed a reactive pleural effusion on the opposite side. Another suffered attack of paroxysmal tachycardia after the operation. Otherwise there has been no particular cardiac complication.

Complications due to the linen suture of the bronchial stump have been reported, *e. g.* polyp formation around the suture followed by lung abscess formation on the opposite side as a result of aspiration of the polyp. If the linen suture ulcerates the bronchial mucosa the patient will develop a persistent irritating cough. Therefore, as soon as a patient having undergone a pneumonectomy develops an irritating cough a bronchoscopy must be performed and the linen suture removed through the bronchoscope. One of our patients presented this symptom. Following the removal of the suture the cough disappeared immediately.

Late Results.

No conclusive evidence exists as to the late results of pneumonectomy for bronchiogenic carcinoma, as there are no larger materials available with a sufficiently long observation period. However, several cases of five-years survival have been reported. Of the 14 patients surviving the operation in our material 4 have died, all of their cancer. Three of these died 4 months after the operation and one 5 months after the operation. In three of these cases hilar metastases were present at the operation. In the fourth case no local metastases were seen, but autopsy revealed multiple general metastases. Of the remaining 10 cases the following were alive after:

7 years	1 case
6 »	2 cases
5 »	1 case
1 year	3 cases
Less than 1 »	3 »

At the present time we can thus say that at least 4 of 14 patients surviving the operation are alive after 5 years. The prognosis does not, therefore, seem as bad as previously believed. Of the patients with a postoperative survival of more than 5 years one had a squamous-cell carcinoma, two anaplastic carcinoma and one an adenocarcinoma. Remarkable is the fact that in one case with a six-years survival metastases of the hilar glands were found at the operation. The tumor was here a squamous-cell carcinoma. It is also seen that those who died, died shortly after the operation, probably as a result of general metastases being present at the time when the operation was performed. If, therefore, the case is a local technically, operable growth and distant spread has not occurred the prognosis must be assumed as comparatively good. Whether distant spread has occurred or not will usually be revealed within a short period, so that a patient who is alive one year after the operation has a fairly good chance of prolonged survival. But it must once more be emphasized that the only possible way in which the prognosis of bronchiogenic carcinoma can be improved is by an earlier diagnosis.

As regards the inoperable cases the question of radiation treatment arises. As regards the value of this treatment our material is not conclusive as no systematic treatment has been given. It is, however, our impression that the treatment is of less value. We consider poor general condition as a contraindication because these patients are empirically known to be worse from radiation treatment. Another contraindication is extrathoracic metastases, these patients never surviving more than 4 months, even if radiation treatment is given. Active infection and marked pleural effusion are also contraindications to radiotherapy.

Summary.

A material consisting of 80 cases of bronchiogenic carcinoma has been studied with a view to sex, age, location of the tumor, pathology, diagnosis, symptoms, roentgenographic and bronchoscopic findings, operability and postoperative course. There were 27 females and 53 males, a relative female preponderance as compared to other materials. The average age in this material was $51\frac{1}{4}$ years. The highest incidence was found in the age group from 50 to 60 years. The youngest patient was a 19-year-old

girl. 86 % were over 40 years of age. Of the tumors 53 were central, 9 intermediate, 11 peripheral and 7 unclassified. There was a right side preponderance, the tumor in 48 cases occurring on the right, and in 32 on the left side. There was a preponderance of upper lobe tumors, 36 cases as compared to 24 cases where the tumor occurred in the lower lobe, and in 4 cases in the middle lobe. Histological examination was carried out in 61 cases: Anaplastic carcinoma in 23 cases, squamous-cell carcinoma in 22 cases and adenocarcinoma in 16 cases. The comparatively low incidence of squamous-cell carcinoma is probably due to the relative female preponderance in the material.

The symptoms are more closely discussed. Cough was the predominating symptom and occurred in 86 %. In 57 % a cough was the first symptom noticed by the patient. The duration of symptoms on admission was 8.5 months. The duration of symptoms when the patient visited the doctor for the first time was 2 months. The doctor is thus responsible for 6.5 months of the delay in diagnosing the condition. The roentgenographic findings are discussed. The peripheral tumors were all circumscribed tumors. In the cases of central tumors the atelectasis was the predominating symptom, viz. in 55 cases. Pleural effusion was found in 14 cases and necrosis peripherally to the tumor in 5 cases. By planigraphy and bronchography bronchostenosis was demonstrated in 45 of 47 cases. Only in 32 of these cases could biopsy material be obtained by bronchoscopy. Bronchoscopy was performed in 67 cases, 36 positive biopsies being obtained. In addition there were 5 cases where the tumor was seen but biopsy not taken or unsuccessful.

37 cases were clinically considered inoperable. Exploratory thoracotomy was performed in 22 cases, and radical operation in 21 cases (20 pneumonectomies and 1 lobectomy). In two cases the tourniquet method was used. Both of these patients died. The dissection method was used in 19 cases of which 5 died (26 %). The cause of death was: Hemorrhage during the operation, shock at the end of the operation, atelectasis of the remaining lung, bronchial fistula with empyema, embolism to the opposite pulmonary artery. Besides the empyema just mentioned there were 2 cases of postoperative empyema. Of the 14 patients surviving the operation 4 died shortly afterwards, namely 3 within four months and one within five months after the operation. Of the remaining patients one is alive after 7 years, two after 6

years, one after 5 years, three after one year and three after less than a year.

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Recurrence Rate of Hernia in Connection with Brief Confinement to Bed Following Hernioplasty.

By

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For the past few years an increasing number of surgeons have been recommending short stays in bed following operations. The advantages of this method are seen in an appreciable decrease in postoperative complications: fewer respiratory infections, better intestinal function, considerable drop in fatal pulmonary embolism, and generally better postoperative state of health. In addition, the length of hospitalization can be cut down, which is important from a financial point of view.

While more and more surgeons are coming to recognize the benefits of brief postoperative confinement to bed, many are still hesitant in view of what they regard as the hazards of this system, particularly the risk of scar ruptures and postoperative abdominal hernia. This risk is considered to be especially great in hernioplasty, and numerous surgeons still consider that patients should remain in bed for at least ten days and up to two or three weeks in order to avoid the danger of recurrence (BRANDON 1945, EDWARDS 1944, LAVENDER 1943, OGILVIE 1936). Therefore, some surgeons who are in favor of a short stay in bed in connection with laparotomy, nevertheless doubt the wisdom of applying the same principle to hernia operations. A study of the incidence of recurrence in a series of hernia cases in which the stay in bed was brief should be of interest in determining whether the risk of recur-

rence is greater in this type of material. If this should not be the case, it would appear unlikely that the risk of postoperative hernia following laparotomy in patients treated according to the same principle would increase.

The types of hernioplasty that are particularly well suited for an investigation for the above-mentioned purpose are the lateral inguinal interventions in men, partly because the risk of recurrence is relatively great in these cases and partly because the material would be large enough to permit evaluation. In addition, the literature contains plenty of material for purposes of comparison.

According to recent statistics, the mean incidence of recurrence is 21 percent for medial and 12 percent for lateral hernia (MAIR 1945).

To compare statistics, it is essential that a differentiation has been made between medial and lateral hernia, since the risk of recurrence is considerably greater in the former type. Furthermore, the age and sex distribution must be uniform. The risk of recurrence increases with age, which means that the figures for a series including a large number of children would give an unduly favorable picture of the situation. In addition, the risk of recurrence is greater in a material consisting mainly of persons engaged in heavy work. If possible a personal follow-up examination should have been made; otherwise it should be clearly stated that the figures are based on responses to questionnaires. GRACE and JOHNSON reported that at least half the patients who were found on personal after-examination to have suffered recurrence were themselves not aware that this was the case. MAIR's figure for this category was twenty percent. SKINNER, on the other hand, reported that the rate of recurrences was about the same in persons examined personally as those followed up by means of a questionnaire.

Finally, the period of observation must have been sufficiently long. In this respect, it is generally agreed that the majority of recurrences take place within two years of the operation (BRANDEN, 70 percent within one year and 90 percent within two years; BURDICK, 33 percent within two years; LAVENDER, 80 percent within one year; MAIR, 60 percent within six months and 75 percent within one year; NIESSEN, 90 percent within two years; SHELLEY, 30 percent within nine months, 44 percent within one year and 89 percent within two years).

Present Material.

Composition: The material comprises all the cases of lateral, non-incarcerated inguinal hernia in males of fifteen years and older operated on during the years 1943 through 1945 at the Military Hospital in Boden, as well as a comparative series from the same hospital dating from the years 1937 through 1942, or altogether 913 patients. The age distribution appears from Table 1. The average age is 32.3 ± 12.3 years for the 1943 to 1945 series and 32.5 ± 12.2 years for the 1937 to 1942 series. About ten percent of the patients were over fifty years old.

Age Distribution.

	15— 19	20— 24	25— 29	30— 34	35— 39	40— 44	45— 49	50— 54	55— 59	60— 64	65— 69	70— 74	75— 79	80— 84	Total
1937 to 1942	19	159	83	88	40	45	17	10	12	16	14	2	1	1	507
1943 to 1945	5	155	52	65	36	36	13	9	12	11	8	3	1	0	406

Civilians as well as military personnel are treated at the hospital. In the present material, most of the prewar cases were civilians, while military personnel dominated after the war broke out. That the age distribution nevertheless was the same before and after 1943 is probably due to the fact that before the war most of the military patients were recruits about twenty years of age, while a great number of those after the war broke out were older men who had been drafted for military service. The non-military patients were practically all farm and forest workers.

Operative method: In addition to removal of the hernial sac, plastic repair was done without displacement of the funiculus. The latter thus came to lie behind both the sutured obliquus internus muscle and the aponeurosis of the obliquus externus all the way down to the inferior medial angle, where it emerged. It was attempted to make this angle just wide enough to lodge a finger-tip beside the funiculus. The internus muscle was sutured to the inguinal ligament, and the sutures were attached to the junction of the muscle with its aponeurosis. This repair work was reinforced by attaching the medial flap of the externus aponeurosis to the inguinal ligament and then doubling the lateral flap over the whole area.

Beginning in 1942, the suture material used for the deep hernioplasty was stainless metal twine measuring 19×0.08 mm, made by the Fagersta Steel Company. This quality has all the advantages of non-absorbable suture material without irritating the tissues, as silk and linen do. Suture fistulas were only observed in exceptional cases and were much less common than with silk sutures.

Prior to 1942, two weeks in bed was the rule following hernioplasty at the Military Hospital. That year the system of short stay in bed was introduced and began to be applied in all cases of laparotomy. At the same time, the stay in bed was shortened for hernioplasty patients too, and by the end of 1942 the average postoperative period in bed for these cases was slightly over seven days. The corresponding figure for the 1937 to 1942 period was 11.1 ± 3.5 days. The stay in bed continued to be shortened in 1943, and the average for the period 1943 to 1945 was 3.0 ± 0.8 days.

Cutting down the stay in bed resulted in a considerable decrease in the number of days of hospitalization. The average for the latter was 13.5 ± 3.2 days for the first period and 5.3 ± 0.9 days for the second. Following discharge, military personnel were given two or three weeks convalescent treatment in army quarters or at home, after which they were put on light duty for two weeks. As a rule they were back on full duty within six weeks of the operation. Civilians were advised to rest for two or three weeks and then do light work for another fortnight.

Immediate complications: It is difficult to evaluate the immediate complications, due to the incompleteness of some of the case histories. There were 12 postoperative respiratory infections recorded for the 1937 to 1942 period and 18 for the 1943 to 1945 period, while wound infections or postoperative hematomas were noted in 29 cases in the first period and 22 in the second. One case of pulmonary embolism and one of thrombosis were noted on the tenth day in the first group, but neither of these complications appears to have developed in the second group. No deaths occurred.

Incidence of recurrence: The main point of interest in judging the merits of a short stay in bed following hernia operations is obviously whether the incidence of recurrence has increased.

In order to form an accurate opinion on this question, it would undoubtedly have been desirable to have conducted a personal

follow-up examination of all the patients operated on. Unfortunately this was not practicable, and we therefore had to be satisfied with a questionnaire. However, by examining the control material in the same way, the figures for incidence of recurrence in the two groups were comparable and gave adequate information on which to study the main question: was the rate of recurrence higher following a short stay in bed?

The questionnaire was sent out in December 1947 to all the persons operated on from 1937 to 1945. Thus the shortest period of observation was two years. The following questions were asked:

1. Has the hernia recurred?
2. If so, how long after the operation did it reappear?
3. Have you been troubled with pain, discomfort or swelling in the region of the operation?
4. Has your capacity to work been adversely affected by the hernia operation?
5. Are you fully satisfied with the result?

The responses may be summarized as follows:

	No. of replies	No. of deaths	Satisfied	Recurrence	Not satisfied for some other reason
1937 to 1942.....	331	13	285	29	4
1943 to 1945.....	295	4	260	20	11

Answers were received in 72 percent of the 1943 to 1945 group and in 65 percent of the control material. Deducting the deaths — among which there were no recurrences, according to statements by relatives — the material comprised 291 and the control series 318 patients. The rates of recurrence were 6.9 percent and 9.1 percent, respectively. However, the 1943 to 1945 group includes eleven patients and the control group four who, although they had not observed a recurrence, nevertheless replied to the fifth question in the negative, thus indicating that they were not fully satisfied with the result of the operation. The most common complaint was tiredness and a sensation of discomfort, sometimes only following hard work.

Some of the persons in the control group reported that they had been troubled by various symptoms after the operation, but that these had gradually vanished. These persons were included in the satisfied category.

The patients with recurrences and those not satisfied for some other reason together amount to 31, or 10 percent of the 1943 to 1945 groups and to 33, or 10.3 percent of the control material. Here, cases counted as recurrences include not only actual recurrences, but also patients complaining of stinging sensations, discomfort, weakness, etc., and the only cases counted as successful are those in which the patients reported that they were fully satisfied with the results. In this way, the incidence of recurrence corresponds with the average.

The age distribution among the recurrences appears from the following table:

15—19	20—24	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69
1	11	6	4	5	7	3	3	3	3	3

The mean age is 38.4 ± 14.6 years, or slightly higher than for the material as a whole.

Thirty-one, or 63 percent of the recurrences developed within one year, while 41, or 83 percent appeared within two years.

All the figures presented so far refer to the total number of patients operated on only. Bilateral operations were performed in 29 cases in the 1937 to 1942 group and in 12 of the 1943 to 1945 group. There were five recurrences among the 41 bilateral operations, all of them unilateral. The incidence of recurrence in this material is thus only slightly greater in bilateral than in unilateral operations.

The question whether the incidence of recurrence following hernia operations increases with brief postoperative confinement to bed can thus be answered in the negative with regard to the present material.

Summary.

The material consisted of 291 lateral, non-incarcerated inguinal hernia in men over 15 years, all of them treated operatively. The technique of operation consisted of hernioplasty without displacement of the funiculus. Wire sutures were used. The rate of recurrence was ten percent, based on responses to a questionnaire. The postoperative stay in bed was 3.0 ± 0.8 days. The rate of recur-

rence did not differ from that for 318 control cases, which were of the same type and examined in the same way and in which the mean stay in bed was 11.1 ± 3.5 days.

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Acute Painful Torticollis and Cervical Subluxation.

By

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Acute painful torticollis is known to be either traumatic or due to infection (SAIDMAN 1948). Of the latter the most well-known is the so-called nasopharyngeal torticollis. GRISEL (1930) assumed that rotation subluxation between the atlas and epistropheus is the reason for acute painful torticollis of the kind that occurs soon after tonsillectomy or after inflammation of the pharynx, ears or lymphatic glands of the neck. DALLY (1875), KIRMISSON, LANNELOGUE, BROCA and REDARD (1898) had earlier described the same syndrome. GRISEL stated that subluxation was caused by infection and muscular contraction. J. E. BERKHEISERS and F. SEIDLERs arrived at the same result in their cases, as also PIOTET. G. ODELBURG-JOHNSON (1932) and A. DELGOFFE (1934) do not, however, believe in the subluxation shown by P. GRISEL in roentgenograms, and they produced similar photographs of healthy people taken in a certain projection. In their opinion the torticollis is due to arthritis of the upper cervical vertebrae. E. SORREL (1937) considered both these reasons possible. P. SWYNGHEDAUW, G. BONTE and E. LAINE (1946) established in their cases, first an infectious decrease of the calcium content and later rotation luxation of the atlas, and concluded that the cause of GRISEL's syndrome was a slight osteitis or osteoarthritis. NIEVERGELT (1947) showed cases of rotation subluxation following arthritis and, in one case, causing ankylosis of the massa lateralis atlantis and the epistropheus. The cause of torticollis following infection lies mostly between the atlas and the epistropheus.

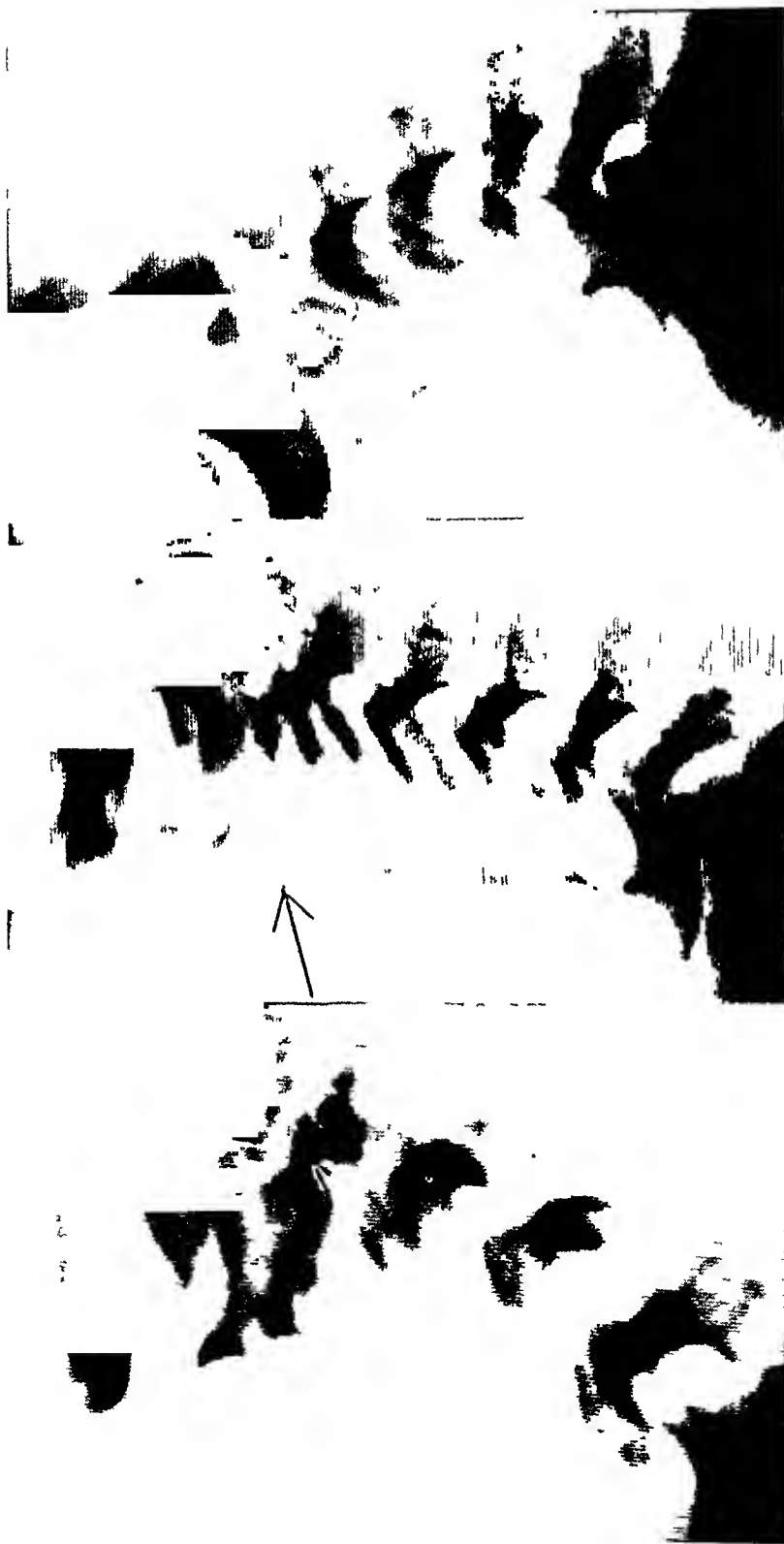


Fig. 1. Case 1. Roentgenogram showing subluxation between the second and third cervical vertebra.

Fig. 2. Case 2. Roentgenogram of the flexed neck showing subluxation between the second and third cervical vertebra.

Fig. 3. Case 2. Roentgenogram of the neck in a position of hyperextension; the dislocation has disappeared.

ROCHER-POUYANNE has described a case of subluxation between the second and third cervical vertebra, and J. SAIDMAN states that tuberculosis of the spine and other local infections may cause pathological luxations in the joints between the various cervical vertebrae. LASSERRE described a case of subluxation between the fifth and sixth cervical vertebra resulting from cervical spondylarthrosis and causing radiating pain in the upper extremity. R. WATSON-JONES mentions that osteoporosis caused by hyperemia may soften the ligaments between the vertebrae causing, among other things, forward luxation of the atlas. He also found that even a very slight trauma may cause subluxation, a sudden forward nodding of the head when a car stops unexpectedly, for instance.

Two cases which the author has observed and which, because of the pathological picture, belong to the afore-mentioned groups, deserve to be reported.

Case 1, nr. 1438/48, was a girl aged $6\frac{1}{2}$ years who had previously been healthy. On Feb. 2, 1948, she felt sick and in the night she woke up complaining of a pain in her neck. Although not otherwise ill she kept her head bent to the left from this day on, intentional or inadvertent efforts to change the position of the head immediately causing crying. 2 months later at the Children's Clinic it could only be established that the neck was in a wry contracted position, the S. R. being 8, the blood count normal, Pirquet —, Mantoux 0.1 mg +. Roentgenography of the cervical vertebrae showed, although not quite clearly, subluxation between the second and third cervical vertebra. When the head was kept in hyperextension the pain disappeared immediately. The head and neck were fixed in a plaster collar in which the patient felt well. In a little less than a month the collar was removed and the patient was free of symptoms. The head moved freely. 3 days later the patient suddenly felt great pain in the neck and the same abnormal position of the head was established. Hyperextension of the neck again brought immediate relief. Having been treated with a plaster collar for 3 months the girl remained free of symptoms. Further control roentgenograms showed nothing abnormal.

The course of the disease, the disappearance of the pain at hyperextension and the final recovery through immobilization together with the uncertain roentgen findings indicate cervical subluxation. Its etiology remains unclear. A slight unnoticed trauma is just as possible as a nasopharyngeal inflammation. The slight preceding feeling of sickness may be a symptom of the latter. The course of the disease and the negative roentgen findings exclude tuberculous spondylitis in spite of the positive Mantoux.

Case 2, nr. 2373/48, was a girl aged 3 years. Previously healthy as a rule. In January 1948 angina, and in March suppurative otitis on both sides for which she was given penicillin among other things. As the inflammation of the right ear continued, although with reduced intensity, the child was brought to the Ear Clinic at the end of June 1948. The ears were found to be healed, but great tenderness was established on the right side of the neck and the head was fixed in a torticollis position. At the Children's Clinic painful torticollis with contraction on the right side was established. Pirquet + (earlier Calmette vaccinated), S. R. 7 mm, WR —, blood count normal. No certain conclusions could at first be drawn on the basis of the roentgenograms. Renewed roentgenography performed under anesthesia in order to prevent rotation projection, showed a slight subluxation between the second and the third cervical vertebra in flexion. The line formed by the posterior surfaces of the vertebrae in this place showed a broken step-like formation. A roentgenogram of the vertebrae in a position of hyperextension, however, showed no dislocation whatsoever, the subluxation evidently having been repositioned. When the patient was laid on her back the head hanging freely, the pain disappeared immediately in this case also. The final recovery required treatment with a plaster collar for 2½ months.

In this case also the diagnosis of subluxation was confirmed by the fact that the pain ceased immediately when the head was kept in a position of hyperextension. Osteo-arthritis following the otitis seems to be etiologically probable. Even an incomplete roentgen-examination indicates in this case that the process, diverging from GRISEL's syndrome, was located in the joints between the epistropheus and the third cervical vertebra.

J. SAIDMAN, in his summary, states that torticollis seldom occurs as a direct result of a trauma since a trauma is mostly followed by a luxation fracture with more serious symptoms. Waking up with a painful torticollis, as if having slept in an uncomfortable position, is quite common. Children, particularly girls, fall ill in this way and some preceding infection of the pharynx can mostly be established. According to R. WATSON-JONES the trauma need not be serious in order to cause cervical subluxations and, when it is a question of children, it may often escape attention. Etiologically the cases reported by me do not present anything new. The subluxation, on which there is a certain disagreement, was, however, evident although it cannot by force of circumstances be roentgenologically satisfactorily proved. Cessation of the pain immediately upon hyperextension of the head is a proof beyond dispute that it was a question of a subluxation. In the first case there was even a typical recurrence after an evidently

complete recovery. As, in the second case, the etiology is probably infectious, the subluxation must chiefly be the result of an arthritic loosening of a joint, or of a loosening otherwise caused by inflammatory hyperemia. The uncertain roentgen findings indicate that the site of the subluxation in both my cases was between the second and third cervical vertebra. In the second case the infection originating in the ear evidently affected the intervertebral joint one vertebra lower down than usual. As treatment of painful torticollis extension of short duration with the aid of Glisson's apparatus and thereafter the usual supporting collar of plaster of paris or of some lighter material is recommended. The method used in my cases of letting the head hang back in the bed seems to give a quick result, but the first case showed that in order to avoid recurrence the extension position must be maintained for a long period, at least over a month.

Summary.

The author describes two cases treated by him, girls of 6 and 3 years respectively. In the first case painful torticollis was established in the morning when the girl woke up. There were no preceding diseases or traumas. When the patient was brought for treatment 2 months later, roentgenograms indicated, however not with complete certainty, subluxation between the second and third cervical vertebra. The pain ceased immediately and the neck could be freely moved when the head hung in hyperextension. The plaster collar which had been applied was removed after one month and the girl appeared to be cured. 3 days later the condition suddenly recurred and disappeared again when the head was placed in a position of hyperextension. Recovery was final after treatment with a plaster collar for a period of 3 months. In the second case painful torticollis occurred after an otitis of long duration. Roentgen-examination performed under anesthesia showed subluxation between the second and third cervical vertebra when the head was flexed. Dislocation could not be established in hyperextension. As in the first case, the pain ceased and the contraction loosened when the head was hung in a position of hyperextension. Recovery followed after treatment with a plaster collar for $2\frac{1}{2}$ months. The successful reduction in both cases confirms the diagnosis of subluxation. In the first case the etiology is uncertain. An unnoticed trauma is the probable cause. In the

second case the subluxation is probably the result of arthritis as the pathological picture, with the exception of the location, corresponds to P. GRISEL's nasopharyngeal torticollis.

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Tuberculosis of the Spine.

I. An Analysis and Follow-up Study of 507 Patients.

II. The Mobility of the Lumbar Spine after
Tuberculous Spondylitis.

Oslo, 1949. Price Sw. Cr. 12:—.

By

IVAR ALVIK.

(Author's abstract.)

Part I.

This part deals with certain clinical-radiological conditions in patients who suffered from tuberculous spondylitis and were treated in Martina Hansen's Hospital (Chief: Dr. JOHN HALD) in the 10-year period 1936—1946. In addition to remarks on the diagnosis and differential diagnosis, a few comments are made on the evolution of tuberculous spondylitis, and various forms of the disease are dealt with.

In the analysis special attention is paid to the age and sex distribution of the disease, its symptomatology, onset and duration, other tuberculous lesions in the subjects of spondylitis, the localization and extent of the spondylitis, and the occurrence of abscesses, sinuses, paraplegia and nephrolithiasis in association with tuberculous spondylitis. These findings are to some extent at variance with those recorded in earlier publications.

The principles of treatment applied to this material are discussed with special reference to the comparative merits of conservative and operative treatment. An account is also given of the technique of operative fixation.

The whole of the material has been re-examined, and most of the patients have undergone a clinical and radiological re-examination by the author. Three patients could not be traced.

Of the survivors who were re-examined and who had been operated on, 78.75 % were fully fit for work, and this was the case with 62.34 % of those who received conservative treatment. No one with an observation period under 2 years was included in this study. As the indications for one or other of these treatments were not identical, these figures are not directly comparable. The interval between discharge and fitness for whole-time work was shorter after operative than after conservative treatment.

The most common causes of a diminished capacity for work were subjective back symptoms (pain, tiredness, weakness and stiffness in the back) without demonstrable persistence of active disease or progress of the tuberculous lesion at the same time. Subjective back symptoms existed in some form or other in 62.85 % of all who were alive at the time of re-examination. Greater attention ought therefore to be paid to the treatment of the muscles of the back and the whole of the motor system than has hitherto been the case with prolonged treatment with immobilization.

At the end of the observation period, 17.75 % of the patients in the original material had died. The excess mortality was 9.62, being 9.89 for men and 9.25 for women. The most common cause of death was tuberculous meningitis.

No bone graft defect was observed in any short bone graft (fixation of only the diseased vertebrae). Bone graft defect was observed in 28.86 % of the patients treated with a long bone graft (fixation extending beyond the diseased vertebrae). With only two exceptions all the bone graft defects corresponded to the segment which had not been destroyed. Bone graft defects were very rare in the thoracic spine.

The forms of healing are classified in 7 categories, mainly on the basis of the radiological appearance of persistent bone-cartilage defects. The most frequent forms of healing are those by "complete block" and "corpus defect with disk reduction" which must be regarded as satisfactory forms of healing. An "incomplete block" may be compared with a pseudarthrosis.

Part II.

This part deals with the mobility of the spine in the frontal and sagittal planes in cases of tuberculous spondylitis, 22 healthy persons serving as controls.

The dynamic-static function of the spine, and the significance of muscular spasm and of insufficiency of the muscles of the back are discussed.

These investigations have been carried out on principles and with a technique devised by myself with a view to the radiological registration of active movements in the erect posture and therefore under strain. Flexion in the sagittal plane was registered in the sitting position.

The mobility of the lumbar spine (L.1—5) of persons fit for work after having suffered from lumbar spondylitis was found to be reduced in both planes when a comparison was made with presumably healthy spines. The limitation of the range of movement was found to be greatest in the sagittal plane both with regard to the lumbar spine as a whole and also to movements between individual vertebrae. No compensatory increased mobility between healthy vertebrae beyond the site of fixation or destruction was observed. A certain range of movement between fixed vertebrae showing no radiologically demonstrable bone-graft defect was also observed. A to some extent considerable range of movement was observed in segments which had been destroyed but not fixed.

In conjunction with ordinary conservative treatment, the operative fixation of a tuberculous spine is indicated in a relatively large number of cases.

As a rule, the operative fixation of the lumbar spine should be effected by short fixation of only the diseased vertebrae, whereas when the thoracic spine is involved the fixation should include neighbouring vertebrae.

The fixation should be solid and should include the spinous processes and as much as possible of the arches, right out to their articulations.

The fixation effected by a single bone graft in the spinous processes must be regarded as insufficient.

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DONUM NATALICIUM
SÖDERLUND



Gustav S. Strydom. -

GUSTAVO SÖDERLUND

CHIRURGIAE PROFESSORI,

CHIRURGORUM IN VALETUDINARIO SERAPHIM DICTO PRINCIPI,

PRAECEPTORI ET MEDICO EGREGIO DE ARTE SUA IN

SVECIA PROMOVENDA OPTIME MERITO

ANNOS QUINQUE ET SEXAGINTA FELICITER

PERACTOS GRATULANTUR

COLLEGAE. AMICI. DISCIPULI

DIE III M. SEPT. ANNO MCMXXXIX

Some New Observations Concerning the Symptom "Pallor" in the Inflammation Syndrome.

By

J. ADAMS-RAY and B. PERNOW.

Paleness and cold sweat, both signs of a high sympathetic tone, are symptoms often seen in a person suffering from severe pain, a reflex response evoked through excitation of the pain pathways in the sensory nerves.

If one reads, however, such standard works as, for example, "Pain", by LEWIS (1), one finds little or nothing about the sympathetic reflexes. Even LERICHE (2) who, however, points out the initial vasoconstriction, considers vasodilatation to be the symptom which dominates circulatory disturbances after, for example, trauma. But even he finds it difficult or impossible to explain the indisputable influence which sympathectomy, chemical or surgical, has on post-traumatic pain and oedema. The question is, does vasodilatation really dominate the body's response to trauma, and what happens to the sympathetic response?

In his doctor's dissertation one of us (3), in traumatic hand affections, observed a symptom not previously described, associated with an increased sympathetic tone, viz., a paleness of the whole hand, visible to the naked eye, constituting a sign of increased tone in the capillaries and venules. The symptom was observed in 37 per cent of the cases. It is referred to in the following as "pallor".

It is known, inter alia, through LEWIS' (4) work, that capillaries and venules can contract with such strength that they are able to resist a dilating force of up to 100 mm Hg. Even TINEL (5)

associates oedema with an increased tone on the side of outflow, and in the material there was found a connection between pallor and tumour.

Even between pallor and pain there was a connection. Pallor was, certainly, found more often in those cases with hyperalgesia, than in the rest of the material. It is possible that hyperalgesia is due to the fact that the pain substances, which according to LEWIS (1) are produced through the axon-reflexes in the pain nerves, are concentrated through the increased tone of the side of outflow, for which pallor is an expression.

During further examinations at the Surgical Out-Patients' Department of the Serafimer lasarettet, one of us (A-R.) found that pallor was a particularly common symptom in traumas and infections. It appeared as if pallor, partial or comprising the whole hand, was a fairly consistently occurring symptom, and a work was published together with HAGBERG (6), in which the symptom was objectively studied by a special method.

The principle of the method is the measurement of the reflexion, from identical small areas on the hands, when the surfaces are lighted up with a two-wave-length light. A light with a wave-length of 5,500 Å is used first, in which wave-length haemoglobin has its maximum absorption capacity. The redder the surface, the greater will the absorption be, and, thus, the reflexion less. One has, thus, in the relation between the reflexion in this wave-length, and the reflexion in 7,000 Å, in which wave-length the haemoglobin absorption is quite insignificant, a relative gauge of the proportion of haemoglobin in the skin. This gauge, F, has been fixed so that the higher the F-value, the greater the pallor.

The results of the examination were in the main as follows:

1. Fifty-six cases of hand injury (5 fractures etc., 24 non-infected and 27 infected wounds and other infections) were examined. Of these, 66 per cent were examined 4 to 10 days after the trauma, or after the first symptoms of infection.

In 83.9 per cent there was a definite pallor on one or several of the skin areas examined. In 7.1 per cent there was a possible pallor, and in 8.9 per cent pallor could not be seen.

In six cases the pallor could be seen at the site of the trauma or infection, while in the remainder it could be described as collateral.

2. Pallor was almost certainly due to an increased tone in the capillaries and venules.

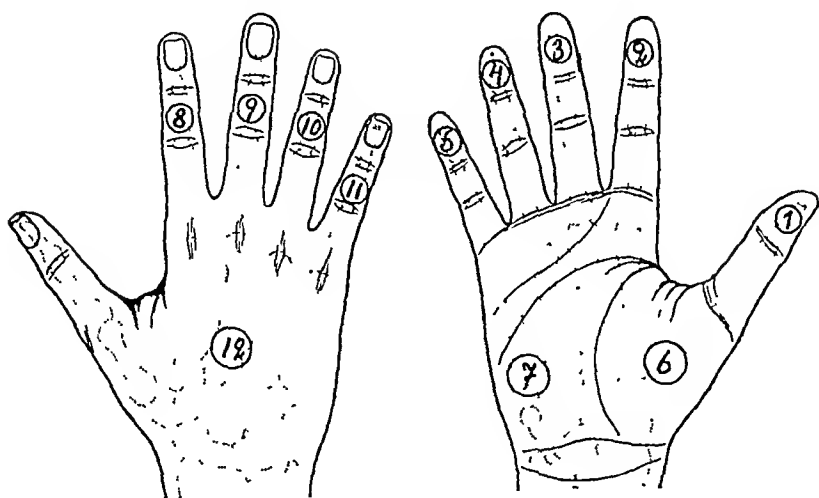


Fig. 1.

3. In five cases the nerves leading from the injury were blocked with a 2 per cent Xylocain. By this, the increased capillary-venule-tone in the area, not supplied by the blocked nerves, was neutralized. The result indicated that the symptom was due to a reflex action through the sympathetic efferent nerves.

4. Vasodilating substances, formed by anoxia and the influence of dry heat, momentarily reduced the increased tone, which, however, fairly quickly recovered.

Pallor comprising the whole hand had, in the only inspected material (3), been observed for the first time on an average of four days after the injury, or on the first day following symptoms of infection in non-traumatic cases.

As a first task we set ourselves to study, with the new method, the first appearance of pallor in hand injuries. In this connection, the localization and development of the symptom were also studied.

A fixed latency time between trauma and pallor appears to be not only of theoretical interest, but also, probably, of practical value. A similar latency time between trauma and oedema is found, in fact, clinically. TÖNNIS (6) has accordingly shown that the first signs of cerebral oedema appear after 2 to 3 days' latency; and, for instance, the emptying troubles after ventricle resection, generally appear first about two days after the operation. A similar latency time between trauma and oedema appears to exist even in hand injuries.

As a start in such an investigation, we studied 25 cases of

clean-cut wounds, caused by sharp instruments, which ran the course without any clinical signs of infection.

In the course of our work we decided to study also the connection between pallor and hyperalgesia. This we did in 14 of the above cases.

Figure 1 denotes the 12 points on each hand (Fig. 1) which were investigated. These points have been chosen, partly because they normally show a certain degree of rubor, and partly because they are technically easy to measure with the existing type of apparatus.

The patients were examined daily from the first day after the injury till definite pallor was established. Later, they were, as a rule, examined on the 7th, 14th, 21st, etc. days after the injury. In four cases, through the courtesy of the patients, daily examinations were carried out during the whole period of the symptom.

The technique employed in the examination for hyperalgesia was as follows: a needle was drawn over the skin in the direction of the wound, and the patient was asked to state when it felt sharper. With repeated determinations, at distances of from half to one centimetre, the hyperalgesic area was ringed round, mapped out and measured.

Results.

I. Pallor.

The 25 cases of incision wounds consisted of 20 wounds localized to the fingers, and 4 to the palm of the hand. In no cases were there any clinical signs of infection.

A. *First appearance of pallor.*

In 24 of the cases (96 per cent) pallor could be shown. In the following Table the first day on which the symptom appeared is shown.

The day after injury on which pallor appeared	1	2	3	4	5	6	7	8
Total number of cases	7	7	5	2	1	1	—	1

Pallor was therefore established on an average of 2.6 days after the injury in 96 per cent of the cases.

With regard to localization on the first appearance of the symptom, the following observations have been made:

1. In three of the seven cases in which pallor appeared already on the first day after injury, pallor was seen on that side of the hand (dorsal or palm) on which the wound was localized.

In three cases, one with a wound on the palm, and the others with a wound on the back of the hand, pallor was seen at all the examined points.

2. For those cases (17 in number) in which pallor occurred the second day, or later, the following applied:

As under 1., pallor was always found at points immediately surrounding the wound. In one case the wound coincided with a measuring point, which showed definite paleness. In general, pallor was spread out dorsally in those cases where the injury was localized to the back of the hand, and both on the dorsum and the palm in injuries localized to the palm of the hand.

3. No relation between the size or position of the wound, and the time of appearance of pallor, has been established.

B. *Further course of pallor.*

1. In 15 cases where the pallor first occurred on the dorsum, it had, in 10 cases, within one to two days, spread even to the palm of the hand.

2. This spreading of the symptom corresponds with an increase in the degree of paleness the first few days after the appearance of pallor.

In four cases F has been determined through daily determinations, by which this chart was obtained. Fig. 2.

3. In 7 cases the F values at the points nearest the injury were higher than those lying further away at the first appearance of pallor. With the ensuing increase of F values this fact remained.

As daily examinations were not done in all cases, the calculated average for the duration of pallor after the first appearance, 10 days, is only approximate.

A collateral spreading rubor was seen in 8 cases, in five cases on the palm, and in three cases on the dorsum of the hand.

The rubor disappeared the day before, or on the same day, the pallor reached its maximum. The redness did not, as a rule, change to pallor, but to the normal colour of the healthy side.

The cause of the latency time between trauma and oedema, in the material presented here, cannot be definitely ascertained.

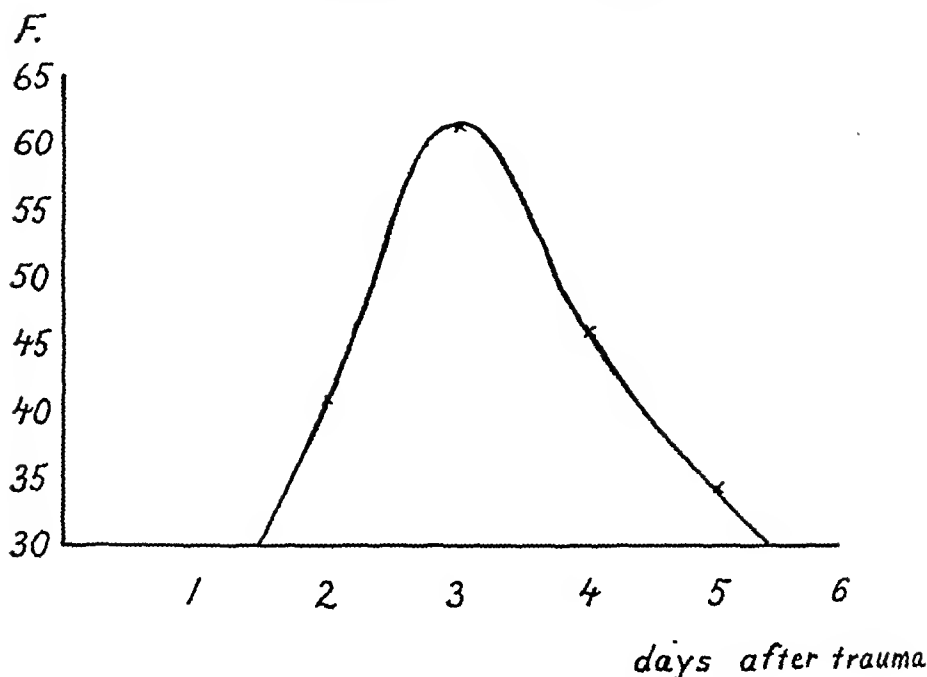


Fig. 2. Degree of pallor, measured daily in 4 cases.

There is a possibility that vasodilatation predominates in the first stage after trauma, so that vasoconstriction cannot take place or be shown. Only when the vasodilating substances become less concentrated, owing to an increased blood flow, can the influence of the sympatheticus appear.

This accords, to a certain extent, with the fact that in the 8 cases where rubor was seen, that is to say, a vasodilatation effect, pallor was first noticed 4 ± 0.6 days after the injury, while in the remaining 16 cases it was first noticed 1.9 ± 0.2 days. The difference of 2.1 ± 0.6 days is, statistically very probable.

With χ^2 -analyses with Yates correction there is also a very probable difference between the two groups ($\chi^2 = 7.7$, $P = 0.01-0.001$). Even the fact that rubor disappeared when pallor reached its maximum, is an indication in the same direction.

The investigations will be continued and expanded, with similar determinations, even in cases of infected wounds, and closed injuries.

II. Hyperalgesia.

Fourteen cases were examined as to the connection between pallor and hyperalgesia.

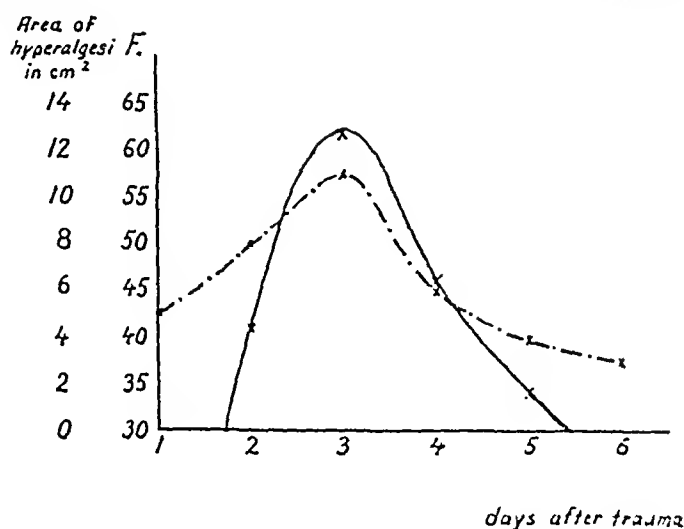


Fig. 3. Degree of pallor (—) and extension of hyperalgetic area (— · —) measured daily in 4 cases.

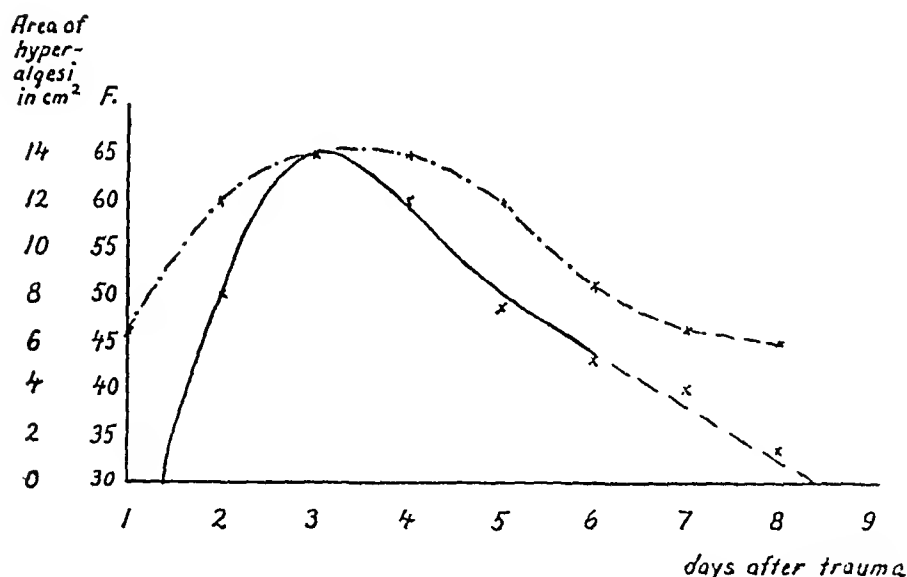


Fig. 4. Degree of pallor (—) and extension of hyperalgetic area in 9 cases. After the 6th day measurements were not made daily.

1. One case in which no pallor was seen on repeated examinations, did not either display hyperalgesia.

2. In the remaining 13 cases a small hyperalgesic zone was seen close to the wound on the day following the injury. In four of these cases positive pallor was seen on the first day.

This zone increased in size each day, and reached its maximum in about 3 to 6 days. At the same time there was a corresponding increase in the degree of pallor. In injuries to the fingers, the

maximum hyperalgesia extended over two-thirds of the whole finger; in injuries to the palm of the hand, it extended over a quarter to a half of the same. Pallor and hyperalgesia then disappeared together, the latter taking a few days longer than the former.

An example of the observations made is seen in Fig. 3 and 4.

3. In one case of injury to the palm of the hand, besides the hyperalgesic area on that spot, a similar area was observed on the dorsum. In a few cases it was observed that after a time, hyperalgesia changed to hypoalgesia.

The material is too small to enable one to draw any definite conclusions regarding the connection shown between pallor and hyperalgesia. However, the hypothesis previously submitted, that an increased tone on the side of outflow could increase the concentration of the pain substances released through the axon-reflexes, and thus produce hyperalgesia, appears to be supported by the observations made.

Further investigations have already been started.

Summary.

I. Pallor, in 24 out of 25 cases (96 per cent) was seen for the first time on an average of 2.6 days after the injury. It often appears first at points immediately surrounding the wound (in one case where the wound and the measuring point coincided, pallor was also found locally), and later has a tendency to spread to other points. In several cases pallor was most pronounced at the point nearest the wound. Pallor shows a tendency to increase so as to reach its maximum after some days, and then to disappear gradually. The approximate duration, after the first appearance of pallor, is on an average 10.5 days.

A collateral rubor was found in 8 cases. It disappeared the day before, or on the same day, pallor reached its maximum, and did not, as a rule, change to pallor. The possibility is discussed that the latency time between trauma and pallor could depend upon a vasodilatation predominance at an early stage, later diminishing, and permitting vasoconstriction to appear in the capillaries and venules.

II. In fourteen cases daily examinations were made concerning both pallor and hyperalgesia. In one case neither pallor nor hyperalgesia appeared. In the remaining thirteen cases a hyperalgetic zone appeared. Its increase and abatement corresponded

with a similar function in pallor. The hyperalgesia persisted a few days longer than pallor.

The possibility of a causal connection between the increased capillary-venule tone, and hyperalgesia, is discussed.

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Steno's Experiment in Man as Complication in Lumbar Aortography.

By

NILS ANTONI and ERIK LINDGREN.

It is about 20 years since aortography was first described by DOS SANTOS, LAMAS and CALDAS. Many diagnostic methods are by no means nearly so old, but nevertheless have become widely used and have had great practical significance. As that is not the case with aortography the question may be advanced — upon what can this depend; is it possible the method of examination who is subject to certain disadvantages, or are there other methods available which give the same information more infallibly or in an easier way? The sphere of application of aortography in the beginning was above all to make clear if there was any tumor in or near the kidneys. According to the opinion of most, aortography for this purpose simply cannot measure up to pyelography or urography. In the majority of cases the results of one of these latter examinations, or both together, in combination with the clinical findings clearly indicate the line of practical treatment. Undoubtedly every roentgenologist with a fair amount of experience in this field has, nevertheless, been confronted by cases in which the question of tumor or anomaly could not be answered with certainty through filling the kidney pelves and calyces with contrast medium. In certain cases the preoperative conclusion as to the nature of an indicated expansive process can be uncertain. Consequently, there is undoubtedly room for a method which would be able to supplement the afore-

mentioned roentgenologic methods of examination of the kidneys. In the work from 1933 which concludes with the words: "N'y a-t-il pas déjà quelques raisons pour croire un peu à l'artériographie rénale?" Dos SANTOS, himself, has convincingly answered the question and shown that in aortography we have that complementary method. But outside of the Spanish-speaking countries, and there, particularly the Dos Santos' school, aortography, in spite of that, has not had wide use. There are probably several reasons. The very operation of itself probably deterred many before wide experience was obtained in puncture of the large vessels. In the beginning there was only the strongly hypertonic and irritating contrast medium, sodium iodide. Dos SANTOS mentions the risk of puncturing the renal artery instead of the aorta and all contrast medium will be thus injected into the artery of one kidney. With the use of sodium iodide as contrast medium this could have an injurious effect on that kidney. Thus, he mentions a "zone dangereux" within which the puncture shall not be made. Since it is impossible to know beforehand where the artery of the kidney lies, every such statement is a simplification that has no great value in the individual case (the position of the kidney can be observed, it is true, but it is not therefore possible to indicate exactly where the kidney vessels go). Finally, aortography is decidedly more circumstantial than especially urography and cannot make clear the pathologic anatomy of the kidney in all respects (provided the contrast medium injected for aortography is not afterward used for delineation of the kidney pelvis' and calyces' anatomical appearance. That presents certain difficulties, however, when aortography is carried out under narcosis).

During the 1940's, however, the interest in aortography has increased especially in America and during the last years, also in our country. In all probability this is in connection with the continually increasing endeavour toward exact preoperative diagnosis, with the added experience in percutaneous puncture of the large vessels, as well as with the introduction of contrast media of per-abrodil type in higher concentrations than previously. Hitherto, judging from the literature, mainly conditions of the arteries of the kidneys and their branches have been examined. Beside information about the vessel supply of the kidney (congenital or acquired ectopia, aberrant vessels as eventual cause of hydronephrosis), occurrence of expansive processes in

the kidneys and their nature, eventual connection of retroperitoneal processes with the kidneys or their more immediate site may also be made clear. Particularly the important question, tumor or cyst, could probably be answered with greater certainty through aortography than with any other method of roentgenologic examination. The only method in the case that might be compared to aortography would be that reported by LINDBLOM: puncture of the expansive process, diagnosed either with urography or pyelography and, if any cavity is encountered, injection of contrast medium into it. The procedure is based, accordingly, upon the method earlier reported by FISH; *i. e.* to puncture the cyst with therapy the object in view, empty it and thereafter inject such a material that the walls of the cyst will grow together. Judging from experiences in the roentgenological department of the Serafimerlasarettet, it appears, however, that the nephrographic effect which becomes more visible with aortography than with urography, perhaps might have also, in certain cases, a greater significance than the study of the site of the trunk vessels. These conditions will not be more closely touched upon here. (It is the intention that later in another connection one of us (L—N) shall give a report of our experiences.) It is not improbable that aortography may also become a successor to lienography with thorotrast.

In order to clearly define the appearance of the aorta itself, no method of examination can replace contrast filling of the aorta. In the cases in which symptoms are found in the lower extremities, which might depend upon alterations in the vessels, arteriography through percutaneous puncture of the femoral artery is first carried out. If it is not possible to show any alterations in the vessels with this examination, a complete clarification can occur only through examination also of the aorta and its main branches in the small pelvis. Experience, namely, has showed that the stricturing wall changes may be located here in certain cases instead of in more peripheral vessels.

The demand for freedom from risk must be greater on a method of examination than on a treatment method. The future use of aortography depends upon whether it can be considered satisfactory from this point of view or whether it is subject to certain risks. HERLINE and MOORE in 1934 made a number of experiments on dogs. They observed that separation of the layers of the aorta and death from traumatic hemorrhage could ensue. As

far as we have been able to determine, however, the finding of any hemorrhage or hematoma that has given clinical symptoms after aortography in man has not been published, nor has any other complication. In isolated cases sections have been made after aortography without observation of any alterations that could be assigned to the examination, with the exception that WAGNER publishes in one of his papers one case with hyalinization and fibrosis of aortic wall at probable site of aortic puncture.

Since we have had the opportunity to observe a case with severe injury to the spinal cord, appearing in connection with aortography, it therefore seems to us of interest to give further details about it here. The ensuing complications can not be assigned, however, to the aortography itself, but rather more to the procedure that was followed.

Johan Erik S., farmer, born 1880 (68 years old). 15 years ago the patient was kicked by a horse; resultant right hip fracture. That leg had since then been noticeably shortened with stiffness in the right hip. Since spring 1948, the patient had pains in the right fibula on walking, which disappeared with rest. The last weeks before admission there were similar difficulties with the lower left leg, in addition there were pains even in horizontal position, wherefore the patient had to spend many nights in sitting position. On internal medication, with priseol per os and in salve etc., positive improvement followed. The patient was cared for in the surgical clinic at the Serafimerlasarettet from Sept. 24, 1948 to Jan. 3, 1949. The general condition on admission was good. There were atrophic skin alterations, with cyanosis, of the right foot and lower leg, on the dorsal surface of the foot a number of small superficial sores. The right foot was colder. In the right leg the pulse could not be palpated anywhere, not even in the femoral artery. The pulse in the left leg and foot was palpable in the usual manner. Roentgen examination showed 1) a rather advanced spondylitis deformans in the lower thoracic and lumbar regions of the spine, with degenerated intervertebral disks and reactive osteophytes on the edges of the vertebrae, 2) a high degree of arthrosis deformans in the right hip joint. Control of skin temperature of the legs after injection of etamon showed an extremely insignificant vasomotor reaction.

Aortography was carried out Sept. 30, 1948, under narcotal narcosis according to the technique we have used in the roentgen department recently. Only the part of the technique which has significance for the understanding of this ensuing complication will be referred to. We have been under the impression that if a pillow is placed under the upper part of the abdomen at the boundary of the thorax, the puncture has been made without difficulty, while in some cases when such a pillow has not been used it has sometimes been difficult to find the aorta. We have got the impression that through the pressure against the abdomen the aorta was held firmly against the spinal column.

RUNSTRÖM, at least, appears to have availed himself of the same procedure. No disadvantages have yet been noticed from it. In the present case the patient was placed in the same way in prone position with a pillow under the abdomen and the narcosis started. The patient was difficult to anesthetize, however, and large quantities of narcotal had to be injected. By degrees the anesthetist had the patient lying quiet but it was only after 30 minutes that an attempt to make the puncture could be undertaken, because before that, the reflexes were not gone out. It proved impossible then to find the aorta at the first attempts. The point of the needle was directed more upwards and the aorta was contacted immediately. Contrast injection proved that only a part of the aorta down to the superior portion of L: 2 and vessels in the upper part of the abdomen became contrast filled. The point of the needle was at the height of the inferior edge of L: 1. A part of the contrast medium also proved to lie perivascularly. A new device for coupling together the needle and the rubber tube leading from the injection apparatus was tried for the first time. It proved to have a certain disadvantage and caused the needle to have a screwing movement during the injection, through which the needle was screwed out of the vessel. Consequently, an increased resistance was felt during the injection which was therefore interrupted, but a certain amount of contrast medium had, however, been injected perivascularly. During the narcosis a laryngospasm began which was quickly relaxed with nicetamid and oxygen inhalation. After the return to the department the patient was disturbingly collapsed (the blood pressure was not taken, however); unconsciousness and confusion continued unusually long. It was not until the following morning that the patient first noticed, with clear senses, that he was paralysed and anesthetic in the legs. The neurologist called in (C. WIDMAN) found absolute paralysis and absolute anesthesia from and including the dermatome Th: 12 or L: 1, the upper abdominal reflexes were present, the lower were absent, cremaster reflexes were absent, muscle reflexes (patellar and achilles) in both legs were entirely absent as were the plantar reflexes, Babinski sign was missing. Incontinence of urine. The same day, Oct. 1, cisternal puncture with tapping of liquor and injection of oxygen was made for myelography. Subarachnoideal space, visualized in the lumbar and the lower thoracic portion, showed normal width and normal contours, the spinal cord extended to the body of the first lumbar vertebra. The liquor was pale gray-yellow, cloudy, Pandy's reaction strongly positive, also Nonne's reaction positive, there was a pleocytosis of 478 white blood cells per cc., 690 red. Heparin treatment was initiated and continued during 3 days and nights. Oct. 14, a bladder fistula was made. Oct. 18, the anesthesia extended up as far as the navel in front, about a hand's breadth above the crest of the ilium in the flank. The leg musculature was already noticeably atrophied. Decubitus sacralis was beginning. Oct. 21, a gangrenous sore appeared on the dorsal surface of the right foot. Nov. 3, a perforation of the urinary bladder was suspected, laparotomy showed breaking through in the vertex of the bladder and the covering peritoneum,

which was sutured, sulfametin was placed in the peritoneal cavity, which was then closed. Nov. 3, the neurologic status showed unchanged conditions, muscular atrophy was further advanced. Nov. 15, phlegmasia alba dolens on the left side. Heparin treatment was reinstituted. Nov. 23, gangrene had spread over a large part of the right leg. Dec. 6, the lower third of the leg was black. Dec. 30, amputation of the leg 1 dm. above the knee was performed, the muscular interstices were infiltrated with fetid pus. Jan. 3, 1949, the patient died of sepsis and bronchial pneumonia.

The section, Jan. 4, 1949 (FALCONER) showed the following: atherosclerosis of moderate degree in the endocardium of the heart, the same of high degree in the coronary arteries, however without obturation or thrombosis. The heart tissue flaccid, gray-brown, somewhat muddy, but without cicatrices. The aorta showed, particularly in its abdominal part, a high grade atherosclerosis. The lower intercostal arteries and lumbar arteries were cut up and examined, but it was impossible to observe any noteworthy alterations. The right common iliac artery was abundantly filled with obturing, older and fresher thrombus masses. In the left femoral artery and vein there were partially organized thrombi. Microscopically the aorta showed pronounced atherosclerosis, but no traces of traumatic lesion. In the connective tissue in this vicinity in isolated places a lymphocytic infiltration of moderate degree. No arterial thrombus could be established. In two lymph glands adjacent to the aorta intensive stasis and edema appeared, but without inflammatory reaction worth mentioning.

The microscopic examination of the spinal cord (N. A—i) shows mainly the following: Meninges and blood vessels on the whole normal. Isolated arteries in the region of the spinal cord, in the anterior median fissure and in the interior of the spinal cord show slightly thickened walls, "hyalinosis", nowhere is any obliterating process or thrombosis seen, nor any hemorrhage or traces of such. The arteries contain approximately as much, or little, blood as is usually the case post mortem. A particularly high degree of softening exists throughout the entire lumbar and sacral cord. All the way from L: 2 downward, all of the myelin sheaths have disappeared. Within L: 1 and L: 2 the general structure of the spinal cord is still visible, especially in the dorsal half of the organ, where in the columns a typical "Lückenfeld" is present, whose network, to a large extent, still contains axis-cylinders, clearly presented according to Davenport. The posterior root entrance zone and the fibers which originate in the posterior roots and pass through the posterior horn are largely preserved. From and including L: 3 downward the destruction is more fundamental, has the character of necrosis (as well as in the ventral parts of L: 1—2), the structural picture is completely lost, the mass of the organ is transformed into an absolute detritus and to a large degree, liquified; nevertheless, here and there remain accumulations of fragmented axis-cylinders.

The most cranial extension of the ramollition is found in the ventral part of the right posterior column, in Th: 11 and Th: 12, above there is found typical, ascending secondary degeneration of the posterior

columns, the region of the spinocerebellar tracts as well as within a marginal layer around the entire spinal cord (Swank's modification of Marchi's method). In the cervical portion the degeneration of the posterior columns is limited to Goll's tracts.

It is noteworthy that the posterior roots are well preserved, both close to the spinal cord and throughout the entire cauda equina, with the exception of isolated degenerated fasciculi, while the anterior roots in all levels of the lumbosacral portion and cauda equina are completely denervated.

Perivascular injection of larger or smaller quantities of contrast medium has been observed by various authors (DOS SANTOS, WAGNER, RUNSTRÖM) without its having caused clinical symptoms. This was notwithstanding the fact that DOS SANTOS and WAGNER used at least 80 % sodium iodide. In one of Runström's cases approximately 40 cc. of 70 % diodrast was injected, in which case practically all of the contrast medium came extravasularly and spread along the spinal column far up in thorax without any clinical symptoms, whatsoever, resulting from it. Smaller extravasations have been observed also by us in some cases without their having resulted in either subjective or objective symptoms, with the exception of possibly in one case, in which the patient reported diffuse pains in the upper abdomen some hours after the injection. In all of our cases 70 % diodrast (or the comparable dijonon) has been used. Consequently, it appears that the perivascularly injected contrast medium in the present case could not have brought about the complications which ensued. The observations that were made at the attempted aortography, as well as those made from the section and the findings of the examination of the medulla spinalis receive an explanation, however, if an aorta compression occurred with the examination. The aorta compression would then have had its origin in the pillow which was placed under the abdomen of the patient. The same pillow had been in use in about 25 cases previously, with no disadvantageous features, on the contrary we had an impression that the punctures were made more easily. In this case it was, however, an unusually thin, almost emaciated old man, in which an aorta compression undoubtedly might occur considerably more easily than with other patients. That a certain degree of compression may be brought about through the procedure used is shown by attempts undertaken later. In one case, thus, on a relatively thin man, an approximately 40 mm. lower blood pressure in the legs was obtained when he lay on

that pillow than without it. In 10 other cases, however, such a drop in blood pressure could not be established. Experiments were not made under narcosis, in which case the relaxation of the musculature will further facilitate the occurrence of aorta compression.

Motor and sensory paralysis of the lower part of the body occurring through the compression of the abdominal aorta, has been known since 1667, when the Danish anatomist NIELS STEENSEN, "STENO", reported his fundamental experiment on rabbits which has been repeated innumerable times, in physiology laboratories, for study and demonstration. The results of Steno's experiment were long attributed to the ischemia of nerves and muscles. VULPIAN 1866, supported by his knowledge of the special sensitivity to the lack of oxygen of the central nervous system and the gray substance, taught that, on the contrary, it must be a question of a functional interruption of the caudal portion of the spinal cord. SCHIFFER 1869, found, among other things, that the peripheral nerves and muscles long remained normally excitable to electricity in the paralysed animal, a convincing proof of the central cause of paraplegia. The first anatomic control was reported by EHRLICH and BRIEGER 1884. Proceeding from the assumption that in the spinal cord the gray substance should be more sensitive to ischemia than the white, these authors expected that through the experiment an isolated "Ausschaltung des Lendenmarksgrau" could be produced, wherewith they also considered themselves to have been successful. In the gray substance of the spinal cord both nerve cells and also myelin fibers were quickly destroyed. The posterior columns remained uninjured with the exception of a narrow marginal zone along the posterior surface, a new evidence of the "exogenic" origin of these columns, namely from the spinal ganglia, which also remained undamaged as well as the posterior roots. The degeneration in the anterior and lateral columns, that only spared a narrow marginal zone along the anterior median fissure and a similar zone along the outer extent of the cord, was interpreted as secondary to the destruction of the nerve cells in the gray substance; in like manner the total destruction of the anterior roots and their extensions in peripheral nerves.

A succession of investigators, even up to the present time, has pursued the idea presented by EHRLICH and BRIEGER of investigating the reaction of the spinal cord to ischemic insults of

varying duration. Steno's experimental animal, the rabbit, has been most easily used with success. SINGER 1887 was unsuccessful with dogs. ROTHMANN 1899, in dogs, by tying off just below the departure of the left renal artery — the "classic" level with Steno's experiment — obtained no reaction at all, by tying off just above the renal arteries, severe but not absolute or total paresis and hypoaesthesia, which soon disappeared again quickly; only with compression just above the superior mesenteric artery the paraplegia and anesthesia became absolute, but the animals died within a few hours because of the visceral ischemia, necrosis of the bowels and so forth; he was, therefore, not successful, as he had intended, with that animal, to produce secondary degenerations. TUREEN 1936, who worked with grown cats, obtained negative results in the level of the renal arteries, therefore, chose the thoracic aorta just below arcus.

Regarding the spreading of the ramollition, rather little interest has been given to its longitudinal dimensions, the majority of the authors mention nothing at all about it. Rabbits have, according to KRAUSE, 8 cervical roots, 12 dorsal, 7 lumbar, 4 sacral and 6 coccygeal. Their left renal artery should run approximately over the middle of the third lumbar vertebra. Ischemia, by tying off at this level, may therefore be expected to occur approximately from and including the third lumbar segment. The choice of method of blocking must have an effect upon the ischemia, in the question of both degree and level. SINGER found the changes decreased in caudal direction in one case, and the spinal cord below the lumbar enlargement was completely intact; a hitherto unexplained condition. WIENER and MÜNZER 1895, saw how the ramollition began "in der Höhe der 24. Rückenmarkswurzel", that is to say, the fourth lumbar segment, was most pronounced in 26.—27., and below this level "auffallender Weise etwas abzunehmen".

The spreading in transverse direction has been studied much more carefully. All authors who have expressed themselves on the subject, point out how much earlier and more effectively the gray matter is destroyed, compared to the white. Many authors, especially in more recent times have occupied themselves exclusively with the great nerve cells of the anterior horn, as a rich field for more and more refined cytologic studies. The specimens situated in the periphery of the horn have been found to be relatively resistant (SPRONCK 1888, E. KROGH 1944—45).

Ever since EHRLICH and BRIEGER, a number of authors have mentioned that also the nerve cells of the posterior horn have been damaged. Some of Singer's rabbits escaped all paresis despite controlled absence of pulse in the femoral artery, in some cases one posterior horn remained intact; these variations are attributed to variations in the vascular supply, differences as regards the supply of anastomoses. WIENER and MÜNZER, with complete compression of the aorta, obtained total necrosis only in 18 out of 21 cases; in the three remaining rabbits there was destroyed, beside the two anterior horns, only one posterior horn. In such a case ante mortem pain sensation have been found to be preserved to that side, which led the authors to the important assumption that pain sensations are led via the nerve cells of the posterior horn.

The nerve fibers of the gray substance were destroyed just as completely as the nerve cells, with the exception of those coming from the posterior roots. SPRONCK was able to follow these to the anterior horn, but not into it. All of the authors who have discussed that have found the posterior roots and root entrance zone intact, as well as the spinal ganglia (EHRLICH and BRIEGER, SINGER, SPRONCK). In the posterior columns SINGER did not reencounter even the marginal zone of degeneration described by EHRLICH and BRIEGER; SPRONCK on the other hand, finds a slight sclerosis in the most ventral portion of the posterior columns. Only MARINESCO 1896 finds the entire field of the posterior columns degenerated in the lumbar cord, except in its most dorsal portion; higher up, in the cervical and thoracic portion, he finds the degeneration limited to the more dorsal parts of Goll in addition to a marginal zone in Burdach. The anterior and lateral columns are unanimously mentioned as strongly degenerated; the marginal zones described by EHRLICH and BRIEGER have just as unanimously been found completely or partially spared.

That intervertebral ganglia and posterior roots, their extension in the spinal cord and, more or less completely, the posterior columns, escape destruction, has been difficult to explain. The possibility of special vascular supply or better access to collaterals for these parts was considered long ago. SINGER, 1887, injected berlin blue solution in the thoracic aorta under high pressure after compression of the aorta but did not only find — as SCHIFFER 18 years earlier — the spinal cord undyed below the level of compression, but also the intervertebral ganglia. TUREEN, 1936,

injected neutral red intravenously on his cats, after compressing the aorta, some below the renal artery, some in the thorax; in the former case no ischemia at all occurred (the entire spinal cord was dyed), in the latter case the entire spinal cord below the level of compression remained undyed.

Vascularization of the spinal cord has been the subject of several outstanding anatomic investigations, from ADAMKIEWICZ 1866 to SUH and ALEXANDER 1939; the classic work is and will remain the monograph of KADYI 1889. As early as 1869 SCHIFFER, with support of his attempts at injection as well as the necrosis produced by compression of the aorta, pointed out that hitherto one had been altogether too "geneigt, wohl nach den bekannten Erfahrungen am Gehirn, sich eine übertriebene Vorstellung von der Reichhaltigkeit der Gefässanastomosen am Rückenmark zu machen". We know nowadays, especially through Kadyi's studies, that the vascular supply to the spinal cord in predominant degree is transverse, segmental, and that an "anterior spinal artery" does not exist as one continuous, long-reaching blood vessel; instead there is a series or chain of arteries of shorter longitudinal extent. The spinal column is supplied mainly by 6—8 anterior radicular arteries, arteriae radicales Kadyi, 5—8 posterior. The posterior radicular arteries are similar in distribution to the anterior. "The anastomoses, however, are accomplished by two somewhat irregular and incomplete chains located lateral to the midline, close to the dorsal edge of the posterior roots, though in some places one or the other branch may run closer to the midline. All the posterior radicular arteries and their anastomoses are smaller than the anterior radicular arteries and their anastomoses. There is no continuous posterior spinal artery" (SUH and ALEXANDER). A special study has been devoted to "die Arterien der Intervertebralganglien und der peripheren Nerven" by TONKOFF 1898. According to that, intervertebral ganglia of the lumbar region, as well as the thoracic and sacral regions are supplied purely segmentally; in the cervical region a more active anastomosis prevails. According to RAUBER, the ramus spinalis of each lumbar artery divides itself into a ramus (according to TONKOFF, better called ramulus) posterior, medius and anterior; according to RÜDINGER 1863, into a ramus anterior and posterior canalis spinalis and a ramus medullae spinalis (= a. radicalis, KADYI); according to CRUVEILHIER and SAPPEY into a ramus vertebralis, to the anterior or respective posterior

wall of the spinal canal, and a ramus medullaris. Each vertebral ganglion becomes his blood "aus mehreren, wenigstens aber aus zwei Quellen. Als häufigste und wichtigste solehe Quelle erscheint die am Ganglion zum Rückenmarke verlaufende Arterie (der in eine A. radialis sich fortsetzende Ramulus medius), sodann die A. nutritia der hinteren Wand des Wirbelkanals und endlich diejenige Arterie, welche sich an der vorderen Fläche des Canalis vertebralis aufzweigt; letztere tritt meistens nur als Ersatz ein für erstere in Fällen, wo diese fehlt oder zurücktritt" (TONKOFF). All of these ramuli are, however, branches of one and the same lumbar artery, and "jedes Ganglion wird versorgt aus der, dem betreffenden Körpersegment entsprechenden, parietalen Arterie . . . durch die von ihr zum Rückenmarke und zu den Wänden des Wirbelkanals hinziehenden Äste." Such a purely or entirely predominating segmental supply is apparent from the aforementioned injection experiments. It makes no difference that not only the arteries situated on the surface of the spinal cord but also those on the inner surface of the spinal canal (RÜDINGER) form abundant anastomoses.

The sparing of the dorsal portions of the segmental nerves and spinal cord can not, thus, be explained by what is known hitherto of the vascular supply to these parts. That the posterior columns and eventually also the posterior horns react as the posterior roots do, may, it is true, be correlated with the fact that they take their vascular supply from the posterior radicular arteries and the postero-lateral arterial trunk (HERRÉN and ALEXANDER 1939). It is undesirable to speak of "special resistance". E. KROGH has recently endeavoured to show that the nerve cells peripherally situated in the anterior horn owe their greater resistance to their situation nearest to the arterial end of the capillary network.

Hemorrhages and ramollitions in the spinal cord on the basis of hypertony and arteriosclerosis are just as unusual as they are usual in the brain. DRAGESCU, RADU and PETRESCU in 1929 have collected 37 cases of thrombosis aortae, which led to paraplegia in only 7 of them. PREOBRASJENSKI set forth, in 1904, an anterior-spinal-arterial syndrome characterized by severe nutritional disturbance within the ventral half of the spinal cord, while the posterior half remained relatively untouched. Characteristic for the syndrome is a flaccid paraplegia with paralysis of the bladder and rectum, areflexia as well as dissociated anes-

thesia with the preservation of the deep sensibility. The experiments with compression of the aorta on animals, in which the dorsal portion of the spinal cord's and segmental nerves manifested such strong resistance, should, possibly, be taken into consideration in the discussion of the pathogenesis of Preobrazjenski's syndrome. One of us (N. A.—i) has himself seen such a case, apoplectically arisen in an old woman; at section it was shown all of the arteries of the spinal cord and subarachnoidal cavity were open and contained blood, the aorta was moderately atherosclerotically changed, no thrombosis could be found.

Our patient's old age and high degree of atherosclerosis aortae must be taken into consideration with qualifying significance in the deleterious effect of the compression, but also the individual variations of the supply to the medullary vessels must be considered. "There are usually from 6 to 8 large anterior radicular arteries, and it is on that, the spinal cord depends largely for its blood supply. Their distribution is not symmetric. There are usually 1 or 2 in the lumbar region, 1 in the lower thoracic region, none or 1 in the middle thoracic region, 1 or 2 in the upper thoracic region, 1 or 2 in the lower cervical region and 1 in the upper cervical region. The largest is usually the one in the lumbar or lower thoracic region, namely, the *arteria radicularis magna*. This artery measures 872 microns in the adult, is single, not symmetric, and occurs in one side only, more often the left. Its most frequent site is the 2. lumbar segment, but it may be observed at any segment between the 8. thoracic and the 4. lumbar" (SUH and ALEXANDER), Th.: 9—L:3 (KADYI). Next to that, according to SUH and ALEXANDER, come those in the lower thoracic and cervical regions, 510—578 microns. The middle thoracic region often lacks large segmental arteries, sometimes one is found between Th: 5—7. TANON 1908 was able to inject the entire vessel net of the spinal cord from the lumbar arteries, in the thoracic region; above the ninth segment, injections from isolated segmental arteries filled only rather small areas, in the cervical region the areas became somewhat larger.

Why an ischemia of the lumbo-sacral part of the spinal cord, that in a rabbit is so easy to achieve, is so much more difficult to effect in dogs and cats, has had no explanation through differences in the supply to the vessels, demonstrated anatomically or in any other way. In humans compression of the aorta has been used, previously, for the main part in obstetric praxis, in

the treatment of threatened uterine hemorrhage. It is said to have been reported first by PLOUQUET 1797, and again recommended by URSAMER 1845 (quot. GAUSS 1912); it is constantly mentioned in all of the text books and manuals. GAUSS, who in 1912 rendered an account of its application in more than 100 cases, designates it in 1920, on the basis of extensive continuous experience, as a "prompt, sicher, schmerz- und gefahrlos wirkende Methode". GAMPER 1921, recommended a special apparatus proposed by SEHRT for that purpose. In 3 of his cases the hemorrhage continued in spite of effective compression of the aorta, controlled by the pulse in the femoral artery; obviously to be ascribed to the internal ovarian ("spermatic") artery which branches off above the site of the compression and regarded by Luschka as the main artery for the pregnant uterus. ZANGEMEISTER recommends it coolly; post-hemorrhage has occurred, and the method is suggested as "auch in anderer Hinsicht gefährlich", with reference to A. MAYER, whose report has not, however, been accessible to us. Experienced obstetricians, personally questioned by us, have neither seen nor heard of damage to the spinal cord resulting from compression of the aorta.

CL. CRAFOORD has held the thoracic aorta closed more than half an hour on operation for coarctation of the aorta, without being able to find resultant damage to the spinal cord. In experimental examinations on dogs the aorta has also been compressed about half an hour without its having produced any damage (BIÖRCK). In these cases, however, compression occurred in the thoracic cavity, and through collaterals (internal mammary and intercostal arteries) a certain amount of blood has been able to come into the distal parts of the body.

What is the cause of the deleterious effects in the case we have described? The man's age and the advanced atherosclerosis in the aorta could be considered as unfavorable factors; to those must be added the compression exercised under abnormally long time. The possibility is also conceivable that Kadyi's arteria radicularis magna, that plays such a dominating rôle in the nutrition of the lumbar spinal cord, had in this case a more caudal site than usual and thus was located under the point of compression; Suh and Alexander have, as we know, found it as far caudally as L:4.

The anatomical changes in our case coincide, for the most part, in character and localization, with those known ever since EHR-

LICH and BRIEGER 1884, from Steno's experiment on rabbits. Among other things the intact posterior roots were present again, with totally destroyed anterior roots, as well as the comparatively undamaged dorsal portions of the spinal cord which in our case, however, is applicable only concerning the uppermost segment of the focal area. The necrosis is, in a large part, more severe than in the experimental cases, both in degree and extent, the sacral segments and conus medullaris are by no means spared, and the posterior columns are as seriously damaged within the area of ramollition as is described in experimental material only by MARINESCO. It appears, consequently, as if damage to the spinal cord in man, as well as in dogs and cats, were more difficult to achieve through compression of the aorta than in rabbits, but when it occurred in a 68-year-old arteriosclerotic, it occurred to a particularly severe degree and wide extent. It is most noteworthy that in our case ramollition extended so far in cranial direction, severe up to and including L: 1, the uppermost extension even up to Th: 11. It plainly seems as if this can jeopardize the interpretation of the damage that has arisen through compression of the aorta. Of the upper limit of the ramollition in Steno's experiment on rabbits we are, to be sure, only very incompletely apprised through the information in the literature; only WIENER and MÜNZER report an upper limit, corresponding to L: 4. In our case the compression has taken place in the level of the second lumbar artery, and the vascular supply of the spinal cord in that level is, as we know from the anatomic treatises, plainly transverse and segmental. On the other hand it appears, in the few known cases of syndrome of the anterior spinal artery that the extent of the ramollition in a longitudinal direction is great (ZEITLIN and LICHTENSTEIN 1936). HERREN and ALEXANDER 1939 found, with compression of the fifth intervertebral thoracic vein, a ramollition which extended from the second to the seventh thoracic segments. The discrepancies observed, appear, thus, not to constitute insurmountable obstacles to the interpretation we wished to accept.

In the literature we have not been able to discover any previous case of positive Steno's experiment in man, and especially none that was anatomically controlled. Damages to the spinal cord resulting from compression of the aorta must be, under all circumstances, an extremely infrequent occurrence. The following case, in which a compression of the abdominal aorta can be dis-



Fig. 1. Eighth cervical segment. MARCHI-SWANK. Typical secondary ascending degenerations.

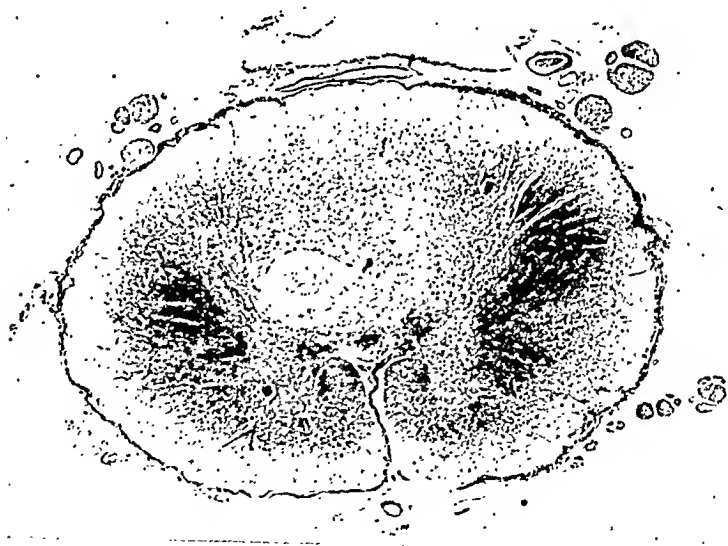


Fig. 2. Eleventh thoracic segment. LADEUR. In the ventral part of one posterior column the cranial end of the primary degenerative focus is visible.

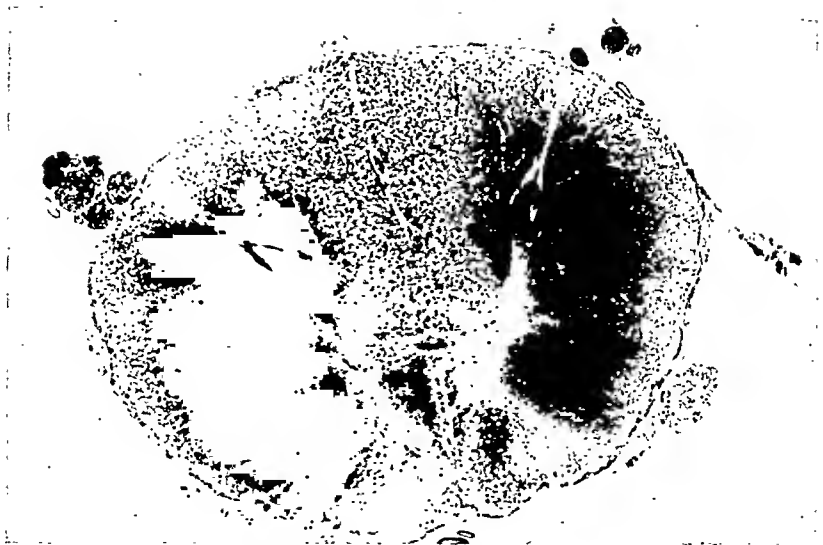


Fig. 3. Twelfth thoracic segment. KULSCHITSKY. In the ventral part of one posterior column, likewise in both antero-lateral tracts, primary degenerated regions are visible.



Fig. 4. Second lumbar segment. HEIDENHAIN'S iron-hematoxylin. The whole parenchymatous substance of the spinal cord is necrotic.

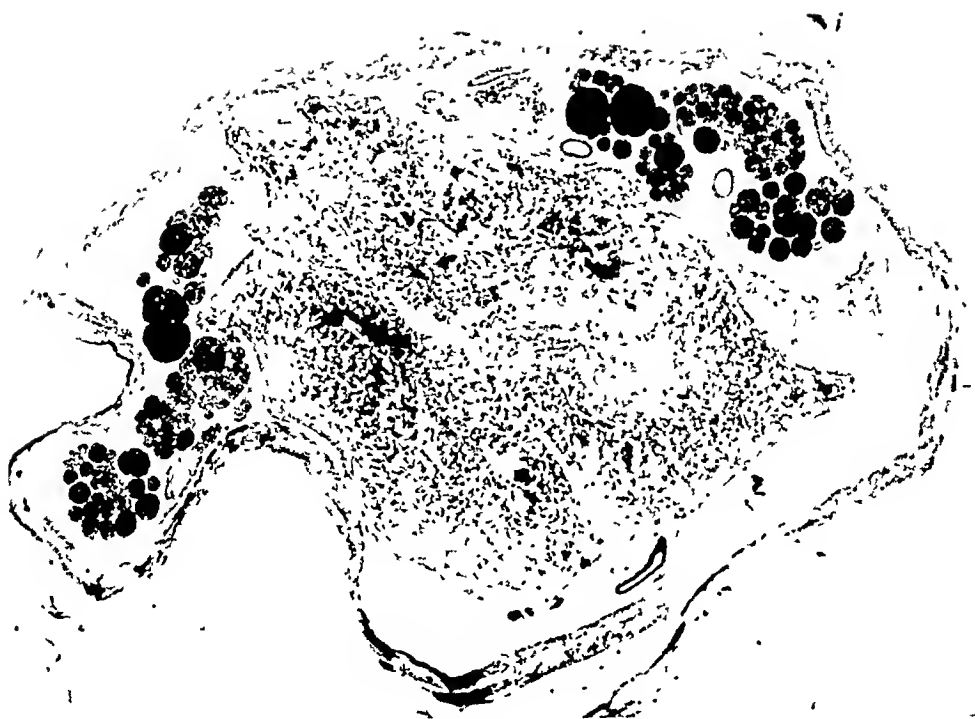


Fig. 5. Fourth lumbar segment. KULSCHITSKY. The spinal cord entirely destroyed. Posterior root fascicles well preserved, anterior entirely denervated.



Fig. 6. Third lumbar segment. Toluidin. Poor rests of nerve cells. Cellular glia augmented.

ANTONI and LINDGREN: Steno's Experiment in Man.

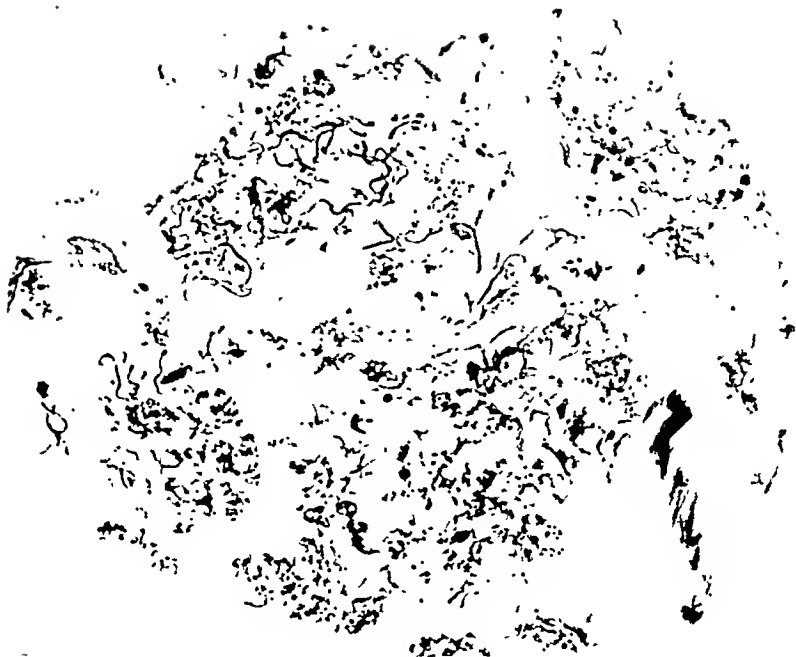


Fig. 7. Third lumbar segment. DAVENPORT. Fragments of axis cylindres swimming in the otherwise almost liquified cord substance.

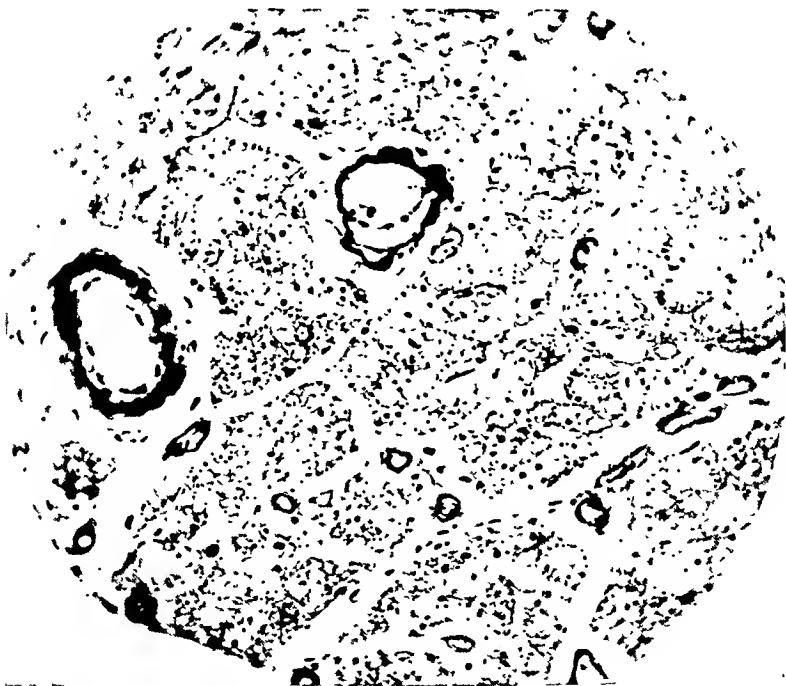


Fig. 8. Third lumbar segment. DAVENPORT. Anterior root, entirely denervated. (The many dark points are nuclei).

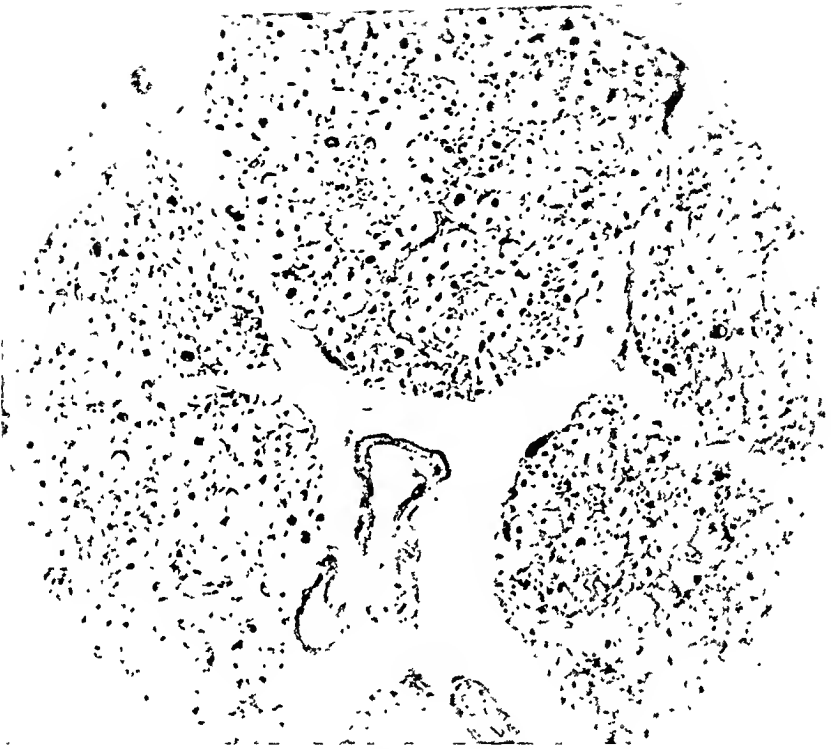


Fig. 9. Third lumbar segment. DAVENPORT. Posterior root.
Axis cylindres preservated.

cussed as possible, perhaps even probable cause of a medullary syndrome, has, therefore, appeared to us worthy of inclusion in this report.

Tage Artur J., born 1911 (37 years). Taxi driver. Previously always healthy, sportsman. Sept. 26, 1948 he had participated in a pleasure excursion, on a steam launch. He had become very intoxicated, felt ill, vomited violently and long. Leaned over the rail in the course of this and in his hypotonic condition, slipped over the boat's railing, which was made of rather thin iron pipes. A compression of the abdominal aorta probably occurred during these actions. When he wakened the following morning, he noticed a paresis in the right leg, of moderate degree; he also felt tingling sensations in that leg on movement. The functions of bladder and rectum were slightly impaired. These disturbances could naturally have been found as well the evening before, although, in the intoxicated condition they were not noticed. The patient visited the out-patient neurological department of the Serafimerlasarettet Sept. 30. There a weakness in the right leg was established, from the hip to the foot, most pronounced at flexion in the knee and dorsal flexion in the foot. There was a hyperesthesia to all qualities in the right leg and also on the right side of the abdomen. The quadriceps reflexes were exaggerated on both sides, most on the right; the right calf (achilles) reflex was more active than the left; the Babinski and Rossolimo signs were present in the right foot. Abdominal reflexes were lacking on the right side, present on the left. The cerebrospinal fluid, sample taken through cisternal puncture, was normal. Radiologic examination of the spinal column detected no abnormalities.

The condition of the patient improved successively and rather promptly. By Oct. 30 it seemed to the patient that the strength in the leg had been re-established. There was no sphincter impairment and no paresthesia. The reflexes of the abdominal wall were restored, there was still a slight exaggeration of the muscle reflexes of the right leg, but the Babinski sign had disappeared. The latest examination, Jan. 11, 1949 showed, to a large degree, the same status, the patient was able to walk without difficulty, could drive his car.

Summary.

In a 68-year-old man, with arteriosclerotic alterations affecting his walking, there occurred in connection with aortography, in abdominal position and with compression of the aorta by means of a pillow, a flaccid paraplegia with anesthesia from and including the lowest thoracic dermatomes, and paresis of the bladder and rectum. After three months the patient died in decubital sepsis and gangrene of the originally affected leg. The section

showed advanced atherosclerosis of the aorta but no trace of traumatic insult, and the lumbar arteries with their branches showed no obvious changes. Medulla spinalis was completely necrotic from and including the first lumbar segment. The uppermost ramification of the necrosis could be followed in the depths of one of the posterior columns up to the eleventh thoracic segment. Above there only typical ascending secondary degenerations were found. The entire parenchymatous substance of the spinal cord was involved by the destruction; within L: 1 the necrosis was still only subabsolute, the axones preserved particularly in the dorsal part of the cord. From and including L: 2 the destruction was absolute and total. The posterior roots were, largely, well preserved, while the anterior showed total denervation. The lesion may be considered to have been caused by the compression of the aorta and the case should constitute the first, up to the present, known instance of positive Steno's experiment in man. The patient's age and aortic atherosclerosis may be ascribed contributory significance.

Also reported, briefly, is a case in an otherwise healthy 37-year-old man, who, during violent vomiting in a highly intoxicated condition, leaned heavily over the railing of a boat and in connection with that developed a spastic paresis of the right leg; compression of the abdominal aorta is discussed as possible cause of his medullar lesion.

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An Anesthesiological Study of 222 Gastric Resections.

By
T. GORDH.

Anesthesia records belong to an organized anesthesia service both for teaching and statistical purpose. Only by means of records of preoperative condition, effects of anesthesia and operation, and a careful follow-up of postoperative morbidity can the anesthetist determine whether his efforts are successful or not. For this study the hole-card system was used, adopted after the type introduced by NOSWORTHY and modified after the anesthesia record used by CONROY at the University of Illinois' hospitals. The card will be seen in Fig. 1. For this special investigation I have collected all my own anesthetics on cases where *gastric resections* have been performed during the last five years (1944—1948). It is thus a strictly personal material from the anesthesia point of view, and from the surgical side the technic is uniform. The material comes from Karolinska Sjukhuset, Serafimerlasarettet, and the private hospitals in Stockholm, and amounts to a total of 222 cases. Most of the serious cases at those hospitals will be found in this material, and the operations were performed by professors in surgery (80 %), assistant professors (14 %), and residents (6 %).

The material is presented in Tables 1 and 2. In the following study of various details, the incidence of postoperative complications from the respiratory and circulatory systems are added, which gives an average view of the postoperative course in general. Both minor and major complications are included and were as fol-

Table 1.
The material.

Pathological condition	Operation performed	Total	Deaths	% mortality
Gastric or duodenal ulcer .	Gastric resection (Billroth II)	173	6	3.4
Gastric or duodenal ulcer with massive hemorrhage	Do.	8	0	0
Postoperative jejunal ulcer	Do.	3	0	0
Perforated ulcer	Do.	6	0	0
Carcinoma	Do.	32	2	6.2
Total		222	8	3.6

Table 2.
Detailed study of the postoperative course.

	Sex		Postoperative complications							Deaths.
	M.	F.	None	Resp.	Circ.	Neurol.	G.-I.	Urol.	Misc.	
Total	162	60	127	30	16	5	42	16	10	8
% of total	73	27	57.2	13.5	7.2	2.2	19.0	7.2	4.5	3.6

Deaths within 1 week 2

» » 2 weeks 3

» > 2 » 3

Table 3.
Distribution by age.

Age	Total cases	Postop. pulm. compl. %	Postop. circ. compl. %	Deaths	% Mortality
21—30.....	16	6.6	0.0	0	0.0
31—40.....	33	12.1	15.1	1	2.9
41—50.....	58	15.6	9.0	1	1.7
51—60.....	58	15.6	5.2	3	5.2
61—70.....	45	13.3	4.4	1	2.2
71—80.....	12	8.3	8.3	2	16.6

lows. *Respiratory complications:* cough (8), bronchitis (6), atelectasis (1), bronchopneumonia (14), pleuritis (1). *Circulatory complications:* severe blood pressure fall, shock (5), internal hemorrhage (3), thrombosis (3), pulmonary emboli (4), heart failure (1).

Table 3 shows a study by age, and as will be observed the majority (53 %) are over 50 years of age. 73 % were males with

an average age of 56 years, and 27 % were females with an average age of 54 years. The average age is thus exceptional high in this material, depending on that it is selected to the extent that the worst risks and the patients with advanced age have been handled by the most experienced anesthetist. All deaths were male, which makes a mortality rate of 4.9 %, and 0.0 % for women. This higher mortality among men is also observed in other statistics. In a recent work by the writer 428 gall-bladder operations were studied and the mortality for males was 4.6 % and for females 0.0 %. As this phenomenon apparently is of great interest, and furthermore little attention seems to have been paid to it, this will be specially considered in the following discussion.

The average age is nearly equal in both sexes (56 and 54), and therefore the age does not give sufficient information for the discussion. And if we study the preoperative physical state of the patients, it will be found that there is no statistically significant difference in either sex.¹ The preoperative respiratory complications in men and women was thus respectively 11.1 % and 8.3 %, and the preoperative circulatory ones respectively 19.8 % and 25 %. The distribution in the different risk groups shows that the average risk of the males is 1.9, and of the females 2.2 according to the grading used by anesthesiologists. This grading is based on the preoperative physical state, and four different groups of severity are recognized. These may be defined as follows:

Risk I. A patient with no organic disease or where the pathological process, to be treated surgically, is localized and is not causing any systemic disturbance.

Risk II. A moderate but definite systemic disturbance caused either by the condition to be treated surgically or by a preoperative complication elsewhere.

Risk III. Severe systemic disturbance from any cause or causes.

Risk IV. A patient with extreme systemic disorders.

No patient with a preoperative complication can be graded as risk I. A patient with no definite preoperative complication may, however, be graded as risk II or III in view of poor muscle tone, senility, debility, obesity, anemia, cachexia, infection etc. The systemic changes by age only will thus place most patients under 50 years of age in risk I, and most patients over 70 years in risk III. The practice to judge the patient entirely on his physical condition as a result of physical, roentgenological, and laboratory

¹ Calculated by ordinary formula (FISHER 1936).

Table 4.
Physical state.

Risk	Total cases	Postop. pulm. complications %	Postop. circ. compl. %	Deaths	% Mortality
I	57	14.0	7.0	0	0.0
II	118	11.8	7.6	3	2.5
III	37	16.2	5.4	3	8.1
IV	10	20.0	10.0	2	20.0

findings will result in much greater accuracy and uniformity than would be the case if for instance only the age or the severity of the proposed operation were taken into consideration. By grading only the physical state, something definite is assumed from the statistical point of view. A special study of the preoperative circulatory complications in this material will, besides complications from other systems, give an idea of the grading. *Risk I*: 0 complications. *Risk II*: hypertension (7), cardiosclerosis (3), hypotension (1), arrhythmia (1). *Risk III*: hypertension (7), cardiosclerosis (8), chronic myocarditis (4), coronary insufficiency (2), auricular fibrillation (1), hemorrhage (3). *Risk IV*: coronary insufficiency (2), congestive heart failure (3), severe hemorrhage (4). Table 4 shows the present material by physical state. In risk I the mortality normally ought to be none, and then gradually increasing with higher risk.

Postoperatively the males seem to be more exposed to complications than the females. Complications from the respiratory system occurred in 15.4 % in men, and only in 8.3 % in the female group, this difference (7.1 ± 4.48), however, not being significant. The postoperative circulatory complication ratio was respectively 8.0 % and 5.0 %, which, however, is not significant either. The types of the post-operative complications are reviewed on page 249. This series contains 7 cases of *thrombo-emboli* with two fatal massive pulmonary emboli. In none of these cases any prophylactic treatment with anticoagulants was given.

Of postoperative gastro-intestinal complications, *vomiting* occurred in 23 % in the females, and 16 % in the males. The part played by sensitivity to anesthetic drugs and analgetics can not be decided, but it is a well known fact that women are more sensitive to morphine and its derivatives than men. Duodenal tube was used when indicated. *Evacuation difficulties* were present in

7 cases (3.2 %), of which five were men, and two women. This frequency is in agreement with the investigations of PERMAN (1935) and BRUUSGAARD (1946). Nutritional jejunal fistula was made in two of these cases, one of which died 2 months after the first operation from subphrenic abscess and empyema. *Hiccup* seems to be a particularly male complication and occurred in 6 males and 1 woman. In the writers material of cholecystectomies there were 5 cases of hiccup, all men. This tendency will also be noted during anesthesia, and is certainly worth further study as this phenomenon is neither patho-physiologically nor clinically sufficiently solved as to cause and therapy. *Paralytic ileus* occurred in 4 cases (1.8 %), three males and one woman. Spinal anesthesia was used in the males and intravenous Narcotal + curare in the female case. Two deaths, both men, occurred in this group. In one case the paralytic ileus was caused by peritonitis from a leaking duodenal stump.

Neurological complications were post-spinal headache (3 = 1.3 %), severe excitation (1), paresthesias (1). In one case the headache was caused by subarachnoidal hemorrhage:

Male. 36. Risk I. Resistant and apprehensive. Spinal anesthesia with heavy Decicain, which wore off during the operation that lasted 2½ hours. The anesthesia was complemented with open drop ether. There was considerable struggling during the induction. Postoperative vomiting and hiccup. When rising the 4th day, the patient complained of severe headache and pains in the neck and the back. There were clinical symptoms of subarachnoidal hemorrhage with stiff neck and slight opisthotonus. No sensory disturbances or paresthesias. No eye symptoms. The spinal fluid was bloody with fresh and old red corpuscles. No bacterial growth. The symptoms gradually subsided and at the discharge from the hospital there were no remaining symptoms from the accident. Even if the neurologist did not think the spinal anesthesia had any connection with this complication, I think the unsatisfactory anesthesia course, the strain from vomiting and hiccup postoperatively together with post-spinal changes in the intraventricular pressure may be the cause of this complication.

The urological complications have consisted in *urinary retention*, and only those where catheterization has been necessary are counted. The frequency was 4.9 % in men, and 11.6 % in women. *Anuria* was a symptom in a patient who died evidencing the picture of hepato-renal syndrome.

This was a 74-year-old man with a polypous tumor in the duodenum. Risk III. Gastric resection was done under spinal anesthesia with light

Table 5.
*Anesthesia.*¹

Anesthetics: Primary and secondary	Total cases	Complications during anesthesia			Postop. resp. compl. %	Postop. circ. compl. %	Deaths	% mor- tality
		Resp. %	Circ. %	G.-I. %				
SPINAL +	169	2.9	25.5	29.5	14.4	7.6	7	4.1
+ intravenous . . .	168							
+ N ₂ O	75							
+ ether	4							
INTRAVENOUS + . .	53	18.8	22.6	7.5	11.3	5.6	1	1.9
+ N ₂ O	48							
+ local	46							
+ curare	42							
+ C ₂ H ₆	3							
+ ether	4							

¹ All patients were premedicated with morphine-scopolamine or its derivatives. Light Nupercaine 1 : 1500 was used in 96 % of the spinal anesthetics. The Swedish made Narcotal was used in 99 % of the intravenous anesthetics.

Nupercain supplemented with intravenous Narcotal. The operation lasted 2 hours. Cirrhosis of the liver was observed and there was a fall in blood pressure for a short time. He died on the 4th day with hepatorenal syndrome of anuria, coma, hyperpyrexia, and jaundice. Cyclopropane would no doubt have been a better choice in this case.

Among miscellaneous complications of interest is found 7 cases with *ruptured wound*, all men. Five of these had postoperative complications from the respiratory tract with cough, and one had postoperative ileus. 2 cases with *septic parotitis* are also included in this group.

The study by anesthesia, as presented in Table 5, reveals that spinal anesthesia was used in 76 % as a primary method. The main indication has been huskiness and obesity. Thus 82 % of the males were given spinal anesthesia, and 56 % of the females. The anesthesia has been supplemented by light intravenous anesthesia with or without nitrous oxide-oxygen with high oxygen concentration. Intravenous anesthesia as a primary choice was used in 24 % and supplemented with local anesthesia in the incision line, nitrous oxide-oxygen, curare or cyclopropane in frequencies according to the table. The main indication has been asthenia, women, and greater risks.

The detailed study of the course of anesthesia shows that only 43 % of the spinal anesthetics and 62 % of the intravenous ones

have been considered satisfactory throughout the anesthesia period. Great demands on the ideal anesthesia have been made, and all deviations from the normal physiological state have been counted. Complications have occurred mainly from the respiratory, circulatory, and gastro-intestinal systems. The main respiratory complications were laryngospasm, bronchospasm, obstructed airway from other causes, respiratory arrest. These were most common with intravenous anesthesia, 18.8 % against 2.9 % with spinal anesthesia, this difference (15.9 ± 3.62) being significant. The circulatory complications were respectively 22.6 % and 25.5 %, thus most common with spinal anesthesia, and were noted as: severe blood pressure fall, fall to or below 70 mm Hg, tachycardia, and arrhythmia. The difference is however not significant.

Gastrointestinal troubles such as vomiting, hiccup, and nausea were also commoner during spinal anesthesia. The frequencies were respectively 29.5 % and 7.5 %, this difference (22.0 ± 5.09) being significant. This complication was in most cases provoked by traction or careless handling of the stomach eliciting a vagal reflex. 33 cases of hiccup were thus caused by this traction reflex, of which 30 occurred under spinal anesthesia, which leaves the cranial vagi untouched. The superficial supplementing intravenous anesthesia does not depress the vagal reflexes either. On the contrary it will increase the vagal irritability, which makes the situation still worse. This circumstance has favoured the use of curare in my own material during the last years. It was also observed that the frequency of postoperative respiratory complications were higher after gastro-intestinal complications during anesthesia (20.4 %), a further reason why every effort to avoid them should be made.

However, all complications during anesthesia and operation have been treated promptly, so that the patients have left the operating theatre in the most satisfactory condition possible, judged by the presence of reflexes and good respiration and circulation. 92 % of the patients have been so awake that they have reacted or replied to questioning. The scheme of treatment may roughly be seen from the frequency of methods used: lowered head-end (70), oxygen (43), intravenous fluid (125), blood transfusion (51), dextran (19), analeptics (26), intratracheal intubation (23). Special attention has also been paid to thorough suction of the throat and respiratory tract during and at the end of operation. By continuous close supervision and endeavour to keep the patient

Table 6.

Duration of anesthesia and operation.

Anesthesia time hrs.	Total cases	Postop. resp. compl. %	Postop. circ. compl. %	Deaths	% Mortality
< 1.....	7	28.5	0	0	0
1 —1½.....	63	14.3	7.8	4	6.3
1½—2.....	90	10.0	6.6	3	3.3
2 —3.....	53	9.4	9.4	1	1.9
3 —4.....	9	22.2	0.0	0	0

in the best possible condition, the duration of the operation will not influence the end results in any significant way. Table 6 shows a study by anesthesia time counted from start of anesthesia to end of operation.

Study of the Eight Fatal Cases.

Case 1. S. 98/47.¹ Male. 71. Risk III. *Preop:* Duodenal ulcer. Cardio-arteriosclerosis. Arrhythmia. *Anesthesia:* Spinal with light Nupercaine + intravenous Narcotal. Satisfactory. *Postop:* Sudden death on the 9th day. *Autopsy:* Thrombosis in both legs. Massive pulmonary emboli.

Case 2. R.K. 941/45. Male. 65. Risk II. *Preop:* Duodenal ulcer. Neurasthenia. *Anesthesia:* Spinal with light. Nupercaine + Narcotal + N₂O — O₂. Blood pressure fall. *Postop:* Vomiting. Ruptured wound. After 4 weeks while arising, sudden death. *Autopsy:* Massive pulmonary emboli.

Case 3. S. 1059/46. Male. 60. Risk II. *Preop:* Gastric ulcer. Chronic bronchitis. Serum protein 6.2 %. *Anesthesia:* Spinal with light Nupercaine + Narcotal. Hiccup. *Postop:* Shock. Bronchopneumonia. Ruptured wound from coughing. Treated with Dextran, penicillin, secondary suture. Stimulants. Death on the 8th day from circulatory failure. *Autopsy:* Pronounced paralytic ileus with enormous amounts of feculent fluid in the intestines. Pneumonia in both lower lobes. Parenchymatous degeneration of the liver and the spleen.

Case 4. K.S. 1118/46. Male. 43. Risk II. *Preop:* Duodenal ulcer. Obesity (100 kg). *Anesthesia:* Spinal with light Nupercaine + Narcotal + N₂O — O₂. Satisfactory. *Postop:* Evacuation difficulties. On the 7th day nutritional jejunal fistula. Reoperation with omental resection under Narcotal + curare (now risk III). Death after 3 months. *Autopsy:* Subphrenic abscess with communication to the pleural cavity. Cardiac insufficiency.

Case 5. S.H. 104/46. Male. 74. Risk III. *Preop:* Polypous tumor in the duodenum. Hypertension. Chron. myocarditis. *Anesthesia:* spinal

¹ Initials of the hospital, record number, and year.

with light Nupercaine + Narcotal + $N_2O - O_2$. Blood pressure fall from 220 to 90 mm Hg. *Postop*: Hepatorenal syndrome with hyperpyrexia, anuria, and jaundice. No autopsy. Marked cirrhosis of the liver was observed at operation.

Case 6. S. 119/47. Male. 56. Risk III. *Preop*: Carcinoma. Anemia. *Anesthesia*: Spinal with light Nupercaine + Narcotal. Satisfactory. *Postop*: Bronchitis. Peritonitis and leakage of intestinal fluid through the wound. Death on the 8th day. *Autopsy*: Diffuse peritonitis from insufficient duodenal stump. Metastases in the regional glands and peritoneum.

Case 7. SH. 30/46. Male. 68. Risk IV. *Preop*: Operated carcinoma of the tongue. Gastric ulcer or carcinoma with hemorrhage. Cachexia, dehydration. Serum protein 4.5 %. Hemoglobin 72 %. Hypotonia. The patient is not able to stand upright. *Anesthesia*: Narcotal + $N_2O - O_2$ + local. Satisfactory. Diagnosis: carcinoma. *Postop*: Remarkably uninfluenced by anesthesia and operation. Symptoms of esophageal obstruction (carcinoma?) developed and the patient declined gradually in cachexia and died 2 months after the operation. No autopsy.

Case 8. SH. 1422/44. Male. 37. Risk IV. Gastric ulcer with repeated hemorrhage. Severe anemia with hemoglobin 50 %. Congestive heart failure with orthopnea and repeated attacks of pulmonary edema. The patient had been hospitalized for one year and because of severe ulcer pains he demanded operation. *Anesthesia*: Narcotal + C_2H_6 + local. Satisfactory. *Postop*: Excellent recovery from the anesthesia and operation. He was sitting up in bed the second day. On the 3rd day, while sitting up, smoking a cigarette, sudden death. *Autopsy*: Severe aortic stenosis with huge enlargement of the left ventricle.

All deaths were thus males in this material. The early mortality within 2 weeks constitutes 5 cases. The cases where the anesthesia might have played some part in the fatal course are probably cases 3 and 5, where a different choice of anesthesia method and prevention of complications during anesthesia might have saved the patients. A most careful choice and administration of the anesthesia is no doubt an important detail in the accomplishment of the operations in gastric surgery.

Studying the anesthetics which have been satisfactory, contra the unsatisfactory ones, will show in the postoperative period, that the respiratory complications were respectively 12.4 % and 14.6 %. The circulatory ones were respectively 5.3 % and 6.4 %. These differences, however, not being significant. Six deaths occurred in the unsatisfactory group, but the difference (3.8 ± 2.45) is not statistically significant. 54 % of all men belong to the category of unsatisfactory anesthetics, and 35 % of all women, the difference (19 ± 7.24) being very probable.

It thus seems as if the male in this material are worse risks in general, and are more apt to have anesthetic and postoperative complications. The same tendency was also found in the authors material on cholecystectomies. It seems very difficult to give an adequate explanation to this phenomenon, which does not seem to be generally recognized. However the males are more resistant to poisons in general, requiring higher concentrations of toxic drugs like anesthetics. In spite of their more vigorous constitution the males may be considered more "worn-out" than the females of the same age group. This circumstance would place them in a higher risk grade, where the postoperative mortality will be higher in any material. Incidentally this tendency is also statistically proved in tables over the average life length, showing a higher average number for the female sex.

Actually this investigation has shown that in judging postoperative results a more accurate view of the material will be obtained by grading the patients by physical state or risk. A qualitative presentation as in table 4 will also give more adequate informations than a purely quantitative one, as in table 1. Providing the anesthesia and operation is "lege artis" performed there ought to be no mortality in risk I, whereas a mortality of 20 % in risk IV may be considered rather normal.

Summary.

222 gastric resections anesthetized by the author are analysed from anesthesiological viewpoint. The total mortality is 3.6 %. The physical state is taken as the basis of grading the patients in four risk groups. Special studies are made by age, risks, anesthesia, postoperative complications, and anesthesia time. The males are found to be more exposed to complications both during the anesthesia and postoperatively. All six deaths were males. This phenomenon is specially discussed, but no adequate explanation can be given. It is further considered that in judging postoperative results a grading of the material by preoperative physical state or risk, will give more accurate informations than a purely quantitative presentation.

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Född den		Tel.	
Grupp			
Diagnos		Kliniska data och laboratorifunders.	
Vid operationen		Vid utskrivningen	
Temp	Puls	E. K. G. m. m.	Frisk
Vikt	Längd		fbd
R. bkr	Hb	Förbehandl. Blodtransf.	afbd
Total Nb	Ber. Total Nb	Dextran	Hb
Blodsocker	Diff	I. v. dropp	Spec.
Spec.	RH	Anaesthetica Hjärtstimulans	
		Ventrikeln tömd kl	Mängd
KOMPLIKATIONER			
PREOPERATIVA		POSTOPERATIVA	
RESP. SYSTEMET		RESP. SYSTEMET	
0 kompl.		0 kompl.	
Övre lufv. inf. Hosta Nosta Bronchit Astma Pleurit		Övre lufv. inf. Hosta Nosta Laryngit Bronchit Pleurit	
Pneumoni Empyem Emfysem Tbc; aktiv stationär		Pneumoni: aspirations-broncho- hypotoni lobär	
Övr.		Trach-bronch. toilet	
Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.			
CIRKULATIONSSYSTEMET		CIRKULATIONSSYSTEMET	
0 kompl.		0 kompl.	
Funkt. störad: 1, 2, 3, 4 Risktyp: statisk, myocardi		Tachycardi Bradycardi Artyrmi Blödning: milt.	
Tagh. coronariinfekt, akad. irredabilir, Klin. diagn.		Övr. Unal blodr. fall shock Emboli Trombos	
VOC. cardiostenos, myocardi		Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.	
Tachycardi Bradycardi Artyrmi Hypertoni Hypo-			
Övr. <i>arteriell hypertoni</i>			
NERVSYSTEMET		NERVSYSTEMET	
0 kompl.		0 kompl.	
Huvudvärk Neurasteni Delirium Psykos Tumor ca-		Huvudvärk: milt, svår Ryggvärk Mat. oro Exaltation	
rebrt Epilepsi Lues Pares		Paralys Pares Psykos Meningit Meningit	
Övr.		Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.	
GASTROINTEST. SYSTEMET		GASTROINTEST. SYSTEMET	
0 kompl.		0 kompl.	
Kvalja, Kräka, Illeus, msk. paralyt Peritonit Ulcus Nicks		Kvalja, Kräka, Ileus, msk. paralyt Peritonit	
Ventrikeln tömd:		Gastrogång & dygnst.	
Övr.		Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.	
UROGENITALSYSTEMET		UROGENITALSYSTEMET	
0 kompl.		0 kompl.	
Retention Hypertri, prost Cystit Pyelit Nefrit		Retention Anuri Urämi Hämaturi Blåsparas	
Övr.		Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.	
ÄMNESOMSÄTTNING		ÄMNESOMSÄTTNING	
0 kompl.		0 kompl.	
Diabetes Obesitas Struma: ataxisk, toxic, infrathorac.		Recurrentes Diabetes Thyreotox. kris Tetani	
Kekhet, deryg. icterus.		Acidos Alkalos icterus Hepato-renalit syndrom	
Övr.		Tidp. för kompl. insätt. 1-3, 4-7, > 7 d.	
ÖVRIGA KOMPL.		ÖVRIGA KOMPL.	
Malign tumor Anemi: milt grav, Oligem. Graviditet Mens.		Sårinf. Sepsis Abscess Brust. lap. sår Anemi	
Föbr: akut, kron.		Övr.	
Övr.		Förber: 1-3, 4-7, > 7 d.	

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(Chief: STURE RÖDÉN M. D.)

The Treatment of Cold Injury.

Experimental Studies on the Extremities of Rabbits.

I. The Effect of Periarterial Sympathectomy.¹

By

STURE RÖDÉN.

The pathogenesis and pathophysiology of cold injury have attracted great interest and may be said to have been investigated and cleared up to a large extent (KILLIAN, LEWIS, LEWIS and LOVE, STRAY). The re-establishment of the normal functions in frozen (frost-bitten) tissues have also been studied, though to a less degree.

Opinions vary considerably with reference to suitable therapy in these important questions. Two distinct lines can be seen, one the Anglo-Saxon and one from the European continent. As regards Russia it is difficult to form any opinion, in spite of their great experience.

It has always been pointed out in English literature ever since LAKE's important work in 1917 that the injured tissues run the greatest risks while being warmed up and that the circulation then deteriorates owing to intense hyperemia, which causes increased edema and stasis; on the other hand the cells require a rapid increase in their supplies of oxygen owing to the rise in temperature. This produces anoxia, which will be considerably less if it is possible for the circulation and the oxygen necessary for the cells to be adjusted to each other (BROWNRIGG 1945, GREENE 1941, KREYBERG 1946 etc.).

¹ This study was made in 1946—47 before I read CRISMONS and FUHRMANS (1947) works.



Fig. 1. Rabbit no. 4, left leg denervated Jan. 31, photo Feb. 9.

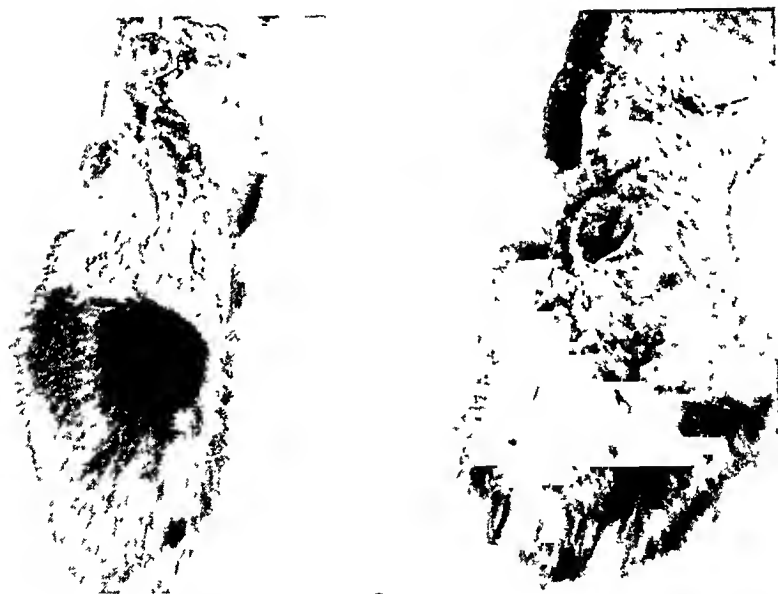


Fig. 2. Rabbit no. 4, photo Feb. 19. Necrosis of the (denervated) left foot.

Those scientists representing the continental opinion consider that the main feature in the picture is vasoconstriction and that every therapeutic attempt must be made to cure it as quickly as possible, ADAMS-RAY (1942), JUNG and FELL (1942), KILLIAN (1942). Others, *e. g.* v. SCHÜRER (1942), KOHLER (1942), are in favour of cautious heating. One of the most effective manner for



Fig. 3. Rabbit no. 6, right leg denervated Feb. 2, photo Feb. 5. note the swollen right foot.

checking the spasm is to resort to surgical measures in the sympathetics. The most ardent adherents of this method consider that it should be adopted as soon as possible (ADAMS-RAY, DUCUING, v. SCHÜRER). Many have made use of it in later stages with manifest results, BERTOCCHI (1940), GIRARDIER (1941), JUNG and FELL (1942), KOHLER (1942) — only blocked —, PHILIPOWICZ (1942) et al., BROWNRIGG. KREYBERG is of the opinion that sympathectomy is contraindicated in early stages and has not been able to show that it is of any value subsequently.

From the above it will be seen how opinions vary, which must probably partly be attributed to the widely different conditions under which cold injuries are incurred and treated.

According to general experience gained resistance to cold as well as constitutional factors, nutrition, fatigue etc. are of extreme importance both with regard to the origin and the consequences of cold injury: such things as outfit and clothing must not be ignored either.

The above will suffice to illustrate the difficulties and manifold problems that arise when attempts are made to find solutions to these questions.

As far as experiments go it is possible to select those which are much more uniform. In the literature that has been at my disposal



Fig. 4. Rabbit no. 6, photo Feb. 19, necrosis of the right foot.

however, I have not been successful in finding any experimental investigations covering the re-establishment and consequences of cold injury in cases of sympathectomy. In earlier experimental investigations of cold injuries, it was nearly always only the most superficial skin injuries that were studied. From a practical point of view these are of comparatively little interest, and consequently I have chosen to freeze the extremities in order to get conditions as analogous as possible to the injuries that are most important surgically. The circulation and the innervation are substantially different in the extremities from what they are in the skin, ears and tail, these being the parts usually used for these purposes.

Problem: How are the course and the results of the injury affected when periarterial sympathectomy is carried out immediately or shortly after an extremity has been frozen?

Method: Rabbits weighing about 2 kg. were used for the tests. They were anesthetized with intravenous dial, 1 ml. 10 % solution per kg. body weight being sufficient for several hours. The hair on both the hind feet was usually cut up to 4 cm. above the heel. Both feet were then put down into a thermos flask containing acetone cooled down to -10 — -30° by means of carbon dioxide. The freezing was generally so effective that the whole foot up to the heel was completely frozen, the joints being rigid. After a time varying from 8 minutes to $2\frac{1}{2}$ hours periarterial sympathectomy was carried out on the femoral artery, according to the method

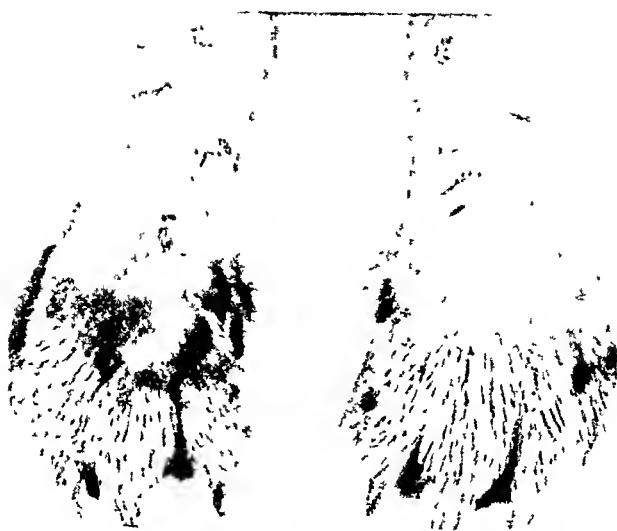


Fig. 5. Rabbit no. 10, left leg denervated Feb. 23, photo Feb. 27.



Fig. 6. Rabbit no. 10. partial and complete loss of the toes on the left foot.

adopted by ROGERS and HEMMINGWAY (1930), namely touching the uncovered artery with 30 % phenol solution, under the strictest observance of precautionary measures.

Owing to the extreme difficulties attached to definitely finding and identifying the lumbar sympathetic, the writer abandoned the attempt after a series of dissection tests. ROGERS and HEM-

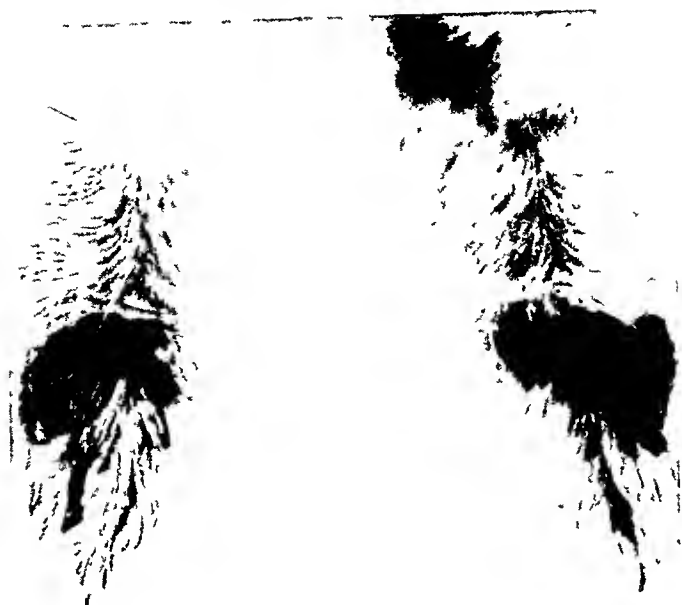


Fig. 7. Rabbit no, 23, right leg denervated May 23, photo June 6. Severe freezing, no difference in the necrosis.



Fig. 8. Rabbit no. 26, left leg denervated June 11, photo June 14, left leg more swollen.

MINGWAY report that when operating on the carotid of rabbit, there was vasodilatation in the ear lasting for 48 hours. They consider the femoral artery too small and did not make use of

Table 1.

Rise in Skin Temperature After Periaxillary Sympathectomy on One Side.

Date 1946	Rabbit no.	Weight in kg.	Sex m. f.	Operated leg right or left	Differences in temperature between operated and unoperated leg hours after operation.						
					1 hr.	2 hrs.	3 hrs.	6 hrs.	20 hrs.	48 hrs.	72 hrs.
30 1	3	3.5	m	r	+ 1.4	+ 1			+ 5.6	0	0
28.2	11	2.8	f	r	+ 1.8			0	0	0	0
5.2	12	4.5	m	l	- 3.5	+ 0.5			0		
5.2	13	2.2	f	r	- 1				+ 1.5		
12.3	14	2.3	f	r	- 2.5				0		
14.3	15	1.9	f	l		- 0.5	+ 1.5		+ 1		
14.3	16	1.9	m	r	- 1	0	+ 0.5		+ 0.5		
4.4	17	2.4	f	r	+ 4.7				+ 1		

the method in this case. The writer has consequently endeavoured to judge the effect by taking the skin temperatures of 8 test animals, see *table 1*. The dial anesthetic brings on a dilatation in the vessels which chills the body, which becomes still colder during freezing the extremities. The time taken for this varies with the temperature approximately as follows: in about 35° 2 mins., in 20—25° 10 mins., in 10—15° 20—40 mins. In some rabbits the time has been found to vary considerably for the two legs, one taking 5—6 times as long as the other. If both are allowed to freeze equally long time, it is obvious that one of them must suffer greater injury. In such animals it is not possible to make use of one leg for control purposes, as this requires an almost equally long time for freezing the two feet.

In a temperature of + 23° the denumbing process will take 20—30 mins. It takes longest in the periphery, though, after 30—35 mins. the toes are about 24—25°. In order to ensure survival the animals must be warmed up, and this can be done on the operation table, though the hind legs must be outside the warm part.

Table 2.

*Results of Freezing Tests Accompanied by One-sided
Periarterial Sympathectomy.*

sw = swollen r = right l = left

Rabbit Nr.	Freezing (in mins.)	Min. temp. —° C	Denervated leg right or left	Time between end of freezing and denervation in mins.	Final results and remarks
4	22	18	l	25	8 days l sw, no fur at all, dull. 20 days left foot necrosis (fig. 2), r healed. 22 days died, much sw in l.
6	25	16	r	30	3 days r sw (fig. 3); 17 days r foot dry gangrene on dorsal side (fig. 4); 21 days r foot and leg dry gangrene. 24 days died. Weight 1,200 gr.
9	30	16	r	45	2 days r much sw; l very little.
10	27	16	l	15	7 days moist necrosis l dorsum pedis; 11 days dry necrosis dorsum pedis + toe 3, toe 2 gone, fig. 6; 16 days died.
23	33	28	r	30	no difference. Serious cold injury with extensive necroses on both sides. Fig. 7.
25	20	17	l	30	light freezed. 36 hours, l much more sw. Later not observed.
26	21	18	l	12	Fig. 8. l much more sw even after 72 hours. Later not observed.
27	33	15	r	17	more sw and ulcers in denervated foot. Both the same after 144 hrs.
43	3	25	r	30	The first 72 hours r more sw, final r = l.
44	9	18	l	35	after 16 days l somewhat more injured.
45	2	30	r	155	most injury in l, which was more sw even previous to denervation.
53	3	40	r	165	lost of toe phalanges, both feet likely injured.

Discussion on the results from the tests in table 1.

Of the 8 animals in table 1, it will be seen that 3 of them reacted with a rise in temperature within 1 hour. After this time the

Table 3.

Survey of Table 2. (Result of Denervation after Freezing.)

	No. of cases	
The denervated foot more severely swollen than the other.	9	(Nos. 4, 6, 9, 10, 25, 26, 27, 43, 44.)
The denervated foot not more swollen than the other.	1	(No. 23.)
The denervated foot less swollen than the other.	2	(Nos. 45 and 53), denervated late.
Final result: the denervated foot more severely injured than the other.	4	(Nos. 4, 6, 10, 44.)
The denervated foot and the other equally injured.	2	(Nos. 27, 43.) No. 23 badly frozen, 53 denervated late.
The denervated foot less injured than the other.	1	(No. 45, the foot more swollen than the other, even before the late denervation.)

temperature sank in the remaining 5, probably due to a primary stimulation from the phenol. Animals no. 12 and 16 did not show a greater rise than 0.5° , and must therefore be regarded as failures or else uncertain. The effect seems to have passed off 48 hours afterwards at the most. Even in the case of no. 3, the rabbit showing the greatest rise, it was over within this time.

The effect of the denervation method adopted.

In $\frac{3}{4}$ of the cases this method causes a rise in the temperature of usually between 1 and 2 degrees, but it generally passes off in 24 and at the most 48 hours. (The temperature measured with controlled Hg thermometers under cotton-wool.)

The results of the freezing and denervation tests will be found in tables 2 and 3.

Discussion.

According to table 1 the denervation method gives positive results in 6 cases of 8. In table 3 there are 10 cases that can be used for judging the effect on one frozen foot. In 9 of the cases there is a greater swelling in the denervated than in the non-denervated foot. In 3 cases it is not possible to follow the changes right through owing to certain complications. In the 7 cases that were observed right to the conclusion, there are 4 with manifest injuries — defects in the tissues — in the denervated foot but

none in the other. In 2 cases the injuries to both feet are of about the same extent. In one case (nr 45) denervated about 2½ hrs. after freezing the final result is the same on both feet. Here, however, the non-denervated foot was more swollen, probably more severely frozen before the denervation.

Result.

Experiments show that periarterial sympathectomy done up to 1 hour after freezing produces a considerably increased edema in the hind foot of a rabbit, and often finally results in a permanent loss of tissue, which does not occur in the other, non-denervated, foot. Denervation resorted to 2 hrs. later seems to have no effect either one way or the other on the injury.

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(Chief: LARS LEKSELL, M. D.)

A New Technique for Craniotomy; the Osteodural Flap.

By

LARS LEKSELL.

Since WAGNER in 1889 (2) introduced the osteoplastic flap, the technique of craniotomy has been considerably improved and refined, but in principle it has remained much the same.

In the method as usually carried out now in this and in most other neurosurgical clinics, the bone flap is sawn through with a wire saw between 4 or 5 burr holes, and is either removed temporarily, or hinged on the temporal muscle. Then the dura is opened, leaving a narrow medial hinge. In closing the wound several precautions must be taken in order to avoid extradural hematomas, formerly a rather frequent complication. Thus the dura, after it has been closed, is sutured to the periost around the bone defect and also, through two small drill holes, to the centre of the bone flap. The closure of the wound is complicated and time-consuming. In this report a simplified operative procedure is described, which can be used in selected cases.

Method.

The proposed method is based on the fact that the dura over the cerebral hemispheres is adherent to the bone calvarium. When exposing the cerebrum one has hitherto always made a temporary halt before opening the dura, but it seems possible in certain cases to open the bone and dura at the same time. If the dura is left attached to the bone, it will not be necessary to suture it when closing the wound. Some years ago the author in one case used a circular saw to cut the bone and dura

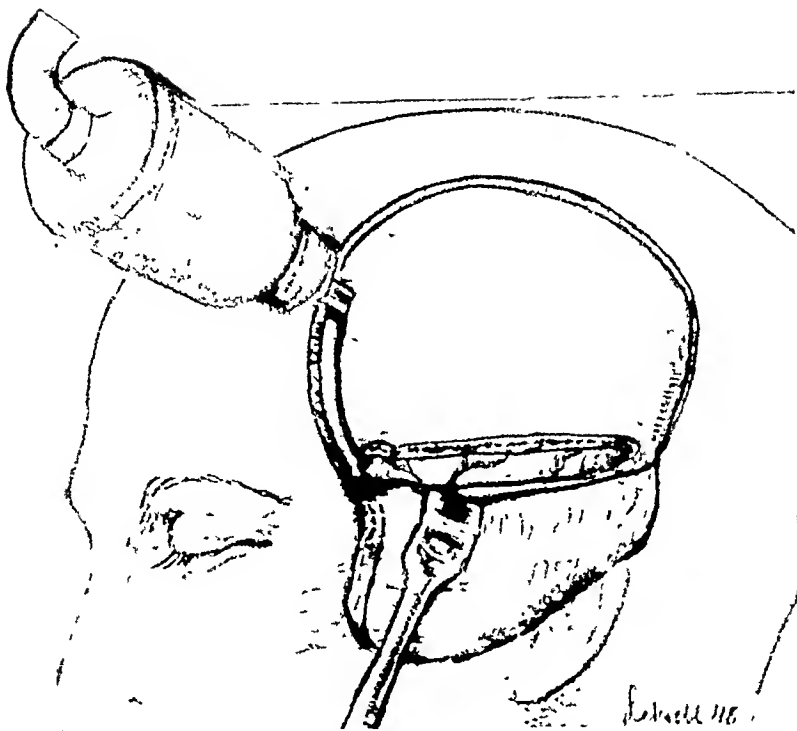


Fig. 1. The bone flap is sawn after the skin muscle flap has been reflected and a basal strip of bone removed.

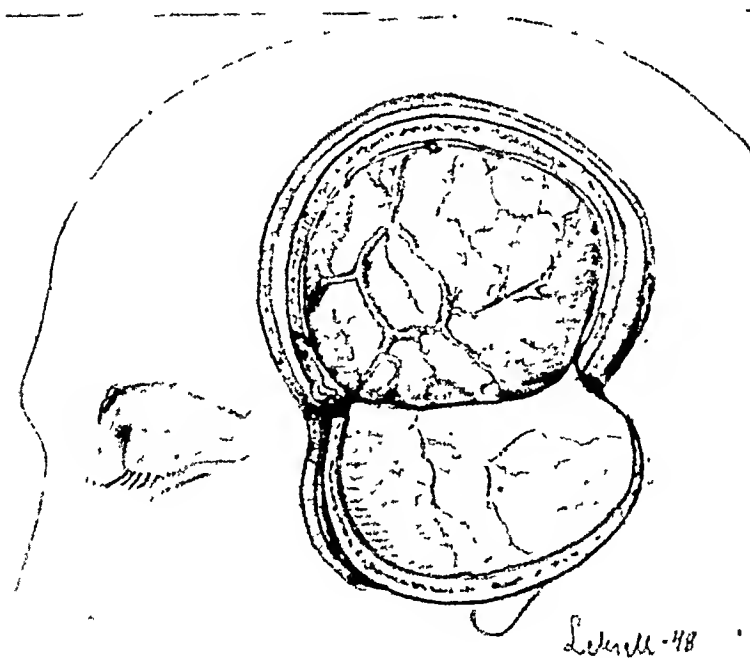


Fig. 2. The dura has been opened with the knife in the saw track and the bone flap is turned down adherent to the dura and hinged on its basal part.



Fig. 3. Case S.B. Left frontal flap. The bone flap has been turned down, hinged on the dura. Dissecting forceps point to the bullet hole in the roof of the orbit.

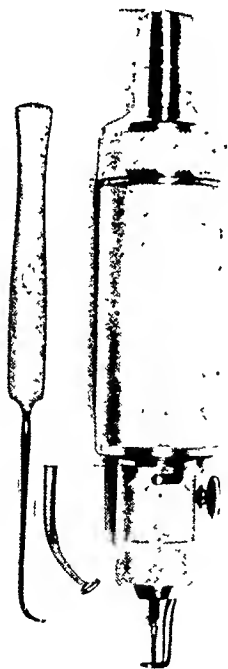


Fig. 4. Pnenmatic rotary saw and curved knife for opening the dura.



Fig. 5. Case S.B. Patient 2 months after operation.

simultaneously. It is more convenient and safer, however, to saw the bone flap first, and then to open the dura through the sawed track. The technique adopted is illustrated in Figs. 1 and 2. The skin muscle flap is first separated from the bone and reflected downwards, a burr hole is made in the basal part of the exposed bone and from this opening a basal strip of bone is first sawn out and removed. The bone flap is then sawn through, preferably with a pneumatic rotary saw, which cuts the bone rapidly, leaving a track about 2 millimeters wide. Pneumatic tools are now widely used in industry and are easily adaptable for cranial surgery (1). After the bone flap has been sawn, the dura is quickly opened in the track by a small curved knife with a transverse knob on the point, to protect the underlying brain surface from injury (Fig. 4). After the dura has been opened, the flap is turned back with the bone still adherent, the basal part of the dura being used as a hinge. When sawing the bone flap, great care must be taken to prevent the bone and dura separating. When the flap has been turned down, bleeding from the dural vessels is controlled by electrocoagulation and with metal clips on the narrow edge of the dura. In closing the wound, no suturing of the dura is required. Thin strips of fibrin film are placed along the edges of the dura, the bone flap being simply replaced and fixed in position.

Comment.

The method described can, of course, only be used in cases where the surface of the brain is not adherent to the dura. It cannot, therefore, be used when a tumor, for example a meningioma, invades the dura of the convexity, nor in flaps close to the midline, where parasagittal veins cross the subdural space. The technique may, however, conveniently be applied in other cases, for example in traumatic epilepsy, where a subdural pneumography has been previously made, or, on the whole, in those cases where it is known, or can be assumed, that the dura is not attached to the surface of the brain. If, when elevating the flap, it is found that the dura is adherent to the brain, the bone can, of course, easily be separated from the dura, and the latter then handled in the usual way.

If carefully executed, the method has some definite advantages compared to the ordinary procedure. The closure of the wound

is not so laborious and extradural hematomas cannot develop. The dural flap is well nourished because it can be made with a broad base without any increased risk of hemorrhage, and postoperative adherences between the brain and the dura will probably be less extensive than after the usual procedure. The absence of foreign suture material gives a clean wound and good healing conditions. In Fig. 3 the appearance of the osteodural flap is shown in a case where this technique has been used.

Case Report.

S. B., a 13 years old boy (No. 74: 48) who, whilst playing with a cartridge which exploded, was injured by a metal fragment which penetrated the left orbit immediately lateral to the eye, passed through the orbital roof and entered the left frontal lobe. He was operated on March 22, 1948, 24 hours after the accident. A medium-sized left frontal flap was turned down. Bone and dura were cut, according to the technique described. The foreign body was located in the basal part of the frontal lobe. It was removed, and the contused brain tissue sucked out. The bullet entrance through the orbital roof was closed with a small muscle graft. Thin strips of gelfoam were applied along the dural edges, and the flap fixed in position with silver-clips. The postoperative course was uneventful. A pneumoencephalogram taken 24 days after the operation (18. 4. 1948) showed a slight widening of the anterior part of the left lateral ventricle. The bone flap was normal.

Summary.

A technique for osteoplastic craniotomy is described, in which the bone and dura are opened together, with the bone flap left attached, and hinged on to, the dura.

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(Chief: Prof. H. OLIVECRONA.)

Papillomas of the Choroid Plexus.

With report of a successfully removed tumour of the left lateral ventricle in a 7 months o'd child.

By

GÖSTA NORLÉN.

Papillomas of the choroid plexus are rare intracranial tumours. Cases in the literature have been compiled by VAN WAGENEN (1930), HERREN (1941) and POSEY (1942).

In Posey's paper there are 86 reported cases. In 22 of these the tumours were diagnosed by surgical methods but only in 5 the tumours seem to have been completely removed. Another two cases with complete removal of the tumour are reported by WALKER and HORRAX (1947), and WILKINS, SMITH and HALPERT (1948). The two last mentioned cases are also of great interest in the discussion regarding the malignancy of these tumours.

From reviews of the literature some interesting facts concerning the appearance and growth characteristics of these tumours can be seen.

In the first decade of life, these tumours are almost exclusively localized to one of the lateral ventricles, while in the second, third, fourth and fifth decades they may occur anywhere, but most commonly in the fourth ventricle. The tumour is also more common in the left lateral ventricle than in the right. In Posey's review 22 were localized to the left lateral ventricle, and 11 to the right.

These tumours are usually benign from a histological point of view, and the histological picture reproduces the histological characteristics of the choroid plexus of infancy (POSEY). In some cases, however, they have a malignant appearance, but according to TURNER and SIMON papillomas which show sufficient microscopic evidence of malignancy to merit the term carcinoma are

particularly rare. Of the 45 cases reported by VAN WAGENEN only 5 could be considered as carcinomas of the choroid plexus. In some cases an interesting phenomenon called seeding has been described. In those cases secondary implants occur in various locations to which tumour cells are transferred through the current of the cerebrospinal fluid.

Whether the histologically malignant tumours are malignant also from a clinical point of view is not clear. WILKINS, SMITH and HALPERT (1948) have reported a case of papilloma of the left lateral ventricle in a 6 years old boy with histological malignancy. The growth was successfully removed, and the child is alive and well 4 years after the operation. WALKER and HORRAX (1947) report a very interesting case in a 44 years old man with a papilloma in the posterior fossa. The tumour was removed three times. The first operation was performed in 1936, the second in 1942, and the last operation in 1946. The tumour showed each time adenocarcinomatous characteristics. In spite of that the patient has remained in relatively good condition for over ten years since the initial removal of his malignant papilloma.

Since the number of successfully operated cases is very small, as also the cases followed up for a long time after the operation, it might be of interest to report the following cases and give some data about the 15 cases of papilloma observed at our clinic.

J. Nr. 771/48. Female; age 7 months. Born February 2, 1948. Normal delivery. Birth weight 3,200 grams. Present illness started in August 1948. The parents observed that the child was not quite well, and perhaps a little more drowsy than usual. On September 11, repeated vomiting and high temperature. The patient was brought to a hospital some days later, where a lumbar puncture was done. The cerebrospinal fluid pressure was 400 mm of water. The fluid was slightly yellowish, and contained 493 red blood cells per cubic mm. Choked discs were observed. The patient was admitted to the child clinic in Stockholm, and then to the neurosurgical clinic on September 24, 1948.

On admission, the patient was rather drowsy and apathetic. Length 71.5 cm, weight 9,100 grams. Head size 46 cm. The anterior fontanelle under high pressure. Bilateral choked discs. Babinski sign positive bilaterally. No other neurological symptoms.

X-ray examination. The size and the development of the skull corresponded to the age of the patient. No destruction and no intracranial calcifications could be seen. The cranial sutures were widened, indicating increased intracranial pressure.

Ventriculography. On September 30, ventriculography was done (fig. 1 and 2), which showed pronounced hydrocephalus including the whole ventricular system. The posterior part of the left lateral ventricle and

the left temporal horn were more dilatated than the rest of the ventricular system. Posteriorly the lateral ventricles were a little dislocated to the right. In the trigonum and in the posterior part of the temporal horn

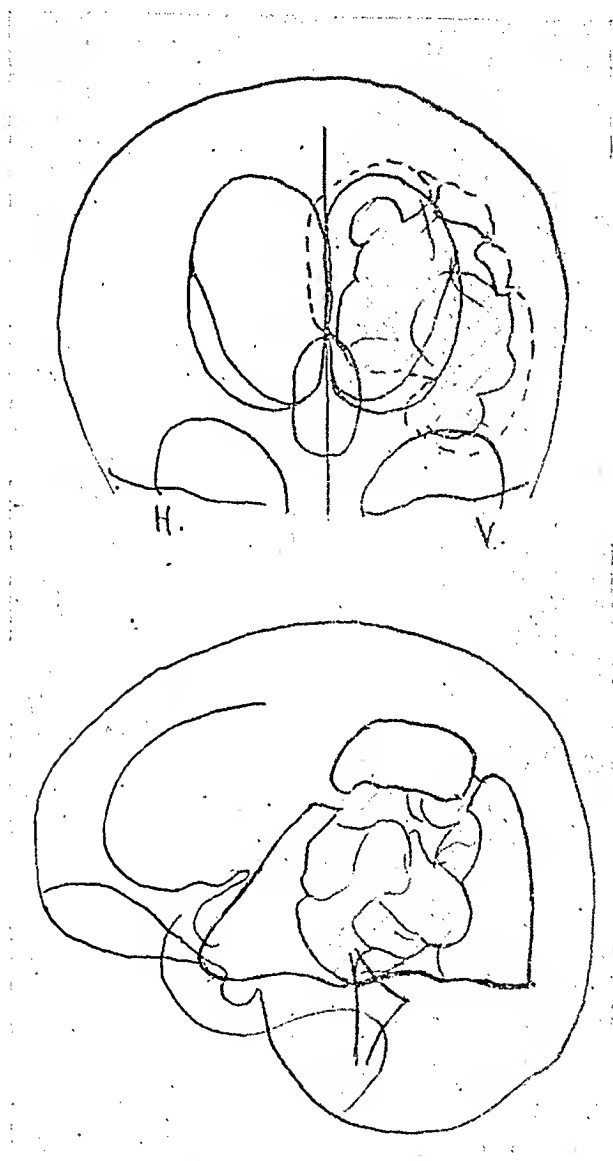


Fig. 2. Drawings of the ventriculogram showing the broad adhesion of the tumour to the basal medial wall of the lateral ventricle and the small adhesions to the upper and lateral walls of the ventricle.

on the left side a lobated intraventricular tumour the size of a mandarine could be seen. The tumour appeared to be adherent to the basal medial wall of the lateral ventricle. In addition, there were, from the superior surface of the tumour, some small adhesions to the upper and lateral walls of the ventricle.

Operation (author). On October 5, operation was performed under intratracheal anaesthesia. A leftsided parietal osteoplastic flap was turned down and the dura opened. An incision was made in the parietal lobe and the lateral ventricle was opened. A large intraventricular papillary tumour was found with thin adhesions to the walls of the ventricle, which were easily cut by diathermy. The tumour was firmly adherent to the choroid plexus, and could be removed totally after

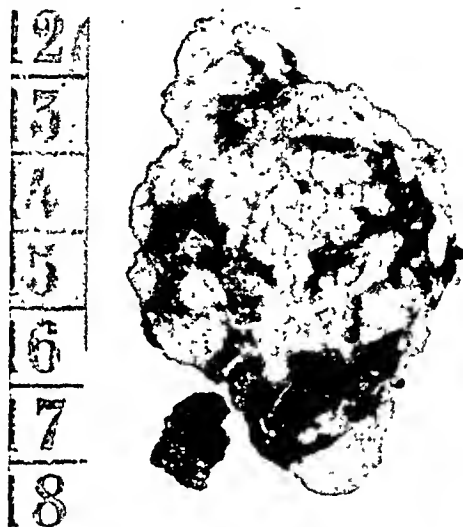


Fig. 3. Gross appearance of tumour removed at operation. Tumour weight 34 grams. The small piece represents the resected part of the choroid plexus.

putting some silver clips on the plexus (fig. 3). Then an excision was made of that part of the choroid plexus to which the tumour had been adherent.

Microscopically the tumour was classified as a papillary adenocarcinoma (fig. 4).

The postoperative course was very good. The patient made a rapid recovery and was able to leave the hospital 13 days after the operation. It was decided not to give any X-ray treatment.

The numerical incidence of papillomas of the choroid plexus in the material of CUSHING of 2,000 verified brain tumours was 0.5 per cent. The 15 cases observed at our clinic represent 0.4 per cent of the total number of cases of verified brain tumours which up to December 31, 1948, was 3,664. In ten the tumours were localized to the fourth ventricle. The age of the patients, 5 males and 5 females, varied from 18 to 45 years. In one case, a 6 years old girl, the tumour was found in the third ventricle. In four cases the tumours were situated in the lateral ventricles; in one case in the right, and in three cases in the left. Twelve cases were diagnosed



Fig. 1. Ventriculogram revealing the tumour in the lateral ventricle

NORLÉN: Papillomas of the Choroid Plexus.



Fig. 4. Microscopic appearance of the growth.

by surgical methods, and 3 cases, all of them localized to one of the lateral ventricles, by autopsy. Out of the 10 cases of papilloma in the posterior fossa, the tumour was totally removed in eight. Three of the patients died immediately after the operation. Of the other 5 cases, one died 8 years after the operation from a probable recurrence. Four cases are still living and in good condition 16, 14, 13 and 4 years after the operation. One of these patients was, unfortunately, already amaurotic before the operation. The other cases are back to full working capacity, without any neurological symptoms. The patient with the papilloma in the third ventricle was operated on in 1938 with apparently total removal of the tumour. She was well until 1946, when there were signs of a recurrence. Ventriculography showed signs of a tumour in the posterior part of the third ventricle, but no tumour was found on exploration. Of the four cases of papilloma localized to the lateral ventricles only one was diagnosed by surgical methods. This is the case reported above.

Comment and Discussion.

Papillomas of the choroid plexus during the first year of life are not so rare. In Herren's review of 80 cases there were nine; in 8 cases in one of the lateral ventricles, and in one case in the third. DRUCKER reported in 1939 one case in a newborn infant.

One case, practically the same age, and with the same localisation as the one reported above, was operated on by VAN WAGENEN in 1929, and reported in 1930. After a first exploration of the tumour X-ray treatment was given, and at a second stage the tumour was totally removed. The patient made a good recovery. Microscopically there were no signs of malignancy. In a personal communication, VAN WAGENEN told me that this patient died one and a half years after the report was made, and that at the autopsy there was a seeding of the tumour in the ventricular system.

The case reported by WILKINS, SMITH and HALPERT is another example of a successfully removed papilloma from the lateral ventricle. Morphologically the neoplasm was malignant, but the child is living and well, 4 years after the operation.

These two cases seem to be the only successfully removed papillomas from the choroid plexus in the lateral ventricles.

It is difficult to draw any conclusions regarding the ultimate result in the above reported case from the experiences gained in these two cases. The disappointing result in van Wagenen's case is in contrast to the good result in the other case. From a surgical point of view, the removal of the tumour was very easy. The tumour could be grasped with forceps and lifted out totally, after putting a clip on the plexus. In commenting on his case, VAN WAGENEN says that the anterior part of the plexus was left alone, and that it might have been better to put a clip on it or extirpate it totally. In our case, after removal of the tumour, an excision of the part of the plexus to which the tumour was adherent was made (see fig. 3). This might be of importance in the ultimate result.

The review of the literature is not very helpful in judging the prognosis in this case, which is understandable as the number of successfully operated cases is very small. The percentage of seeding seems to be highest with tumours of the lateral ventricles, and in one third of the cases of seeding the phenomenon occurred within the first decade of life (HERREN). Seeding was present in 9 of Poscy's 86 cases.

In the child, the tumour seems to be more malignant in its local growth characteristics than in the adult.

Of our 15 cases only two showed histological malignancy, both localized to the lateral ventricles.

Our experience corresponds to that of DAVIS and CUSHING that these tumours remain single. Seeding was not observed in any of our cases.

HERREN is of the opinion that the effect of X-ray treatment is uncertain, but probable. In van Wagenen's case, X-ray treatment was given preoperatively, but in spite of that the patient died of seeding. From the histological appearance of the tumours the effect of X-ray treatment seems to us to be questionable.

Summary.

1) A report is given of the successful removal of a papilloma of the choroid plexus in the left lateral ventricle in a 7 months old child. 2) Some data are given about the 15 intracranial papillomas observed at the neurosurgical clinic. 3) All the papillomas in this material have been single tumours. 4) After a complete removal, a permanent cure is to be expected in most cases. 5) A

local recurrence might occur after apparently complete removal. 6) Seeding has not been observed in any of our cases. 7) X-ray treatment seems to us to be of little value.

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The Diagnosis of Intracerebral Hematomas Following Frontal Lobotomy.

By

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Frontal lobotomy performed according to the closed technique of FREEMAN & WATTS has a mortality rate varying in different statistics from 2 to 10 %, the mean being average 3 %. In a collective survey of 1,000 lobotomy operations performed in England and Wales published in 1947 by the British Board of Control 30 fatalities are reported. In the same year FREEMAN & WATTS reported altogether 450 lobotomy cases operated on during the ten-year period 1936—1946, the mortality rate in this series being also 3 %. Lower figures have, however, been published in different series in which another technique has been used. Thus POPPEN in 1948 had 5 deaths in 470 patients in which the so-called open technique of LYERLY had been adopted. With the same technique SCOVILLE & WHITCOMB in 1948 had only 2 fatalities in 240 operations. A series of 100 so-called ice-pick operations with no deaths was reported by FREEMAN the same year. One of his cases was complicated by hemorrhage still not of a degree to necessitate a second intervention.

Within about two-thirds of all these cases the fatal outcome seems to have been caused by postoperative hematomas within the plane of section of the frontal lobes whereas a variety of other causes account for the remaining third. The comment made by the Board of Control on the mortality figures, namely, that "the death rate cannot be said to be high when the seriousness of established mental disorders is taken into account" is doubtlessly justified. The question still must be raised whether these figures cannot possibly be lowered. Postoperative intracerebral hema-

tomas seem usually not to have been subjected to active surgery. Some surgeons even have taken the somewhat fatalistic standpoint of considering them beyond treatment. This standpoint is probably justified in the majority of cases in which clinical signs of intracranial expansion are already present. The nucleus of the problem thus shelled out consists in an early diagnosis, if possible even before the appearance of clinical signs.

From a practical standpoint the question of postoperative clots is of considerable importance. Lobotomy operations are often carried out in neurosurgical departments to which the patients have been admitted only temporarily from mental hospitals. Considering the shortness of neurosurgical beds in this country it is of importance to shorten the postoperative period as much as possible. On the other hand the risks of postoperative complications should to the highest possible extent have been eliminated before the patient is discharged. With other words, the desirability of early being able to rule out postoperative clots is evident.

FREEMAN & WATTS recommended in 1942 the injection of a few drops of lipiodol at the end of the operation in order to visualize the plane of section. In case the transection of the white matter should be incomplete the cut could be enlarged immediately. Under ordinary conditions this would very rarely become necessary. The lipiodol drops may, however, serve another purpose, namely, the early diagnosis of postoperative clots. A shift of the lipiodol drops is probably the earliest sign of intracerebral oozing thus enabling the diagnosis of an intracerebral hematoma even before clinical signs of intracranial expansion have appeared. On the other hand it seems as if an unchanged lie of the lipiodol drops after 24 hours is a reliable check that no oozing has taken place and that the risk of an intracerebral hematoma, thus, practically is absent.

In the Neurosurgical Department of the Södersjukhuset 99 frontal lobotomies have been carried out according to the closed technique of FREEMAN and WATTS during the time interval August 28, 1944—October 31, 1948. All have been bilateral. In 96 instances the whole of the centrum semiovale was transected, in 3 only the orbital halves. 86 of the operations were carried out in psychotic patients, the remaining 13 for various kinds of painful conditions, milder psychic disturbances, Parkinson's disease etc.

In 94 instances a positive contrast medium was injected within the plane of section. Lipiodol was used in 89, immetal in 2 and

pantopaque in 3 instances. In all these a cutaneous test for iodine hypersensitivity had foregone the injections in order to avoid toxic reactions. In one case where the preoperative test showed iodine idiosyncrasy a few silver clips were applied at various levels of the sections in the white matter, in the remaining four instances no contrast of any kind was used.

Primary X-ray control in two planes with an a. p. and a lateral picture was performed immediately after the operation had been finished in all the 95 cases in which contrast of any kind had been injected. In one case it was established that the incision had not been sufficiently deep. A second operation with deepening of the cut was immediately undertaken with a more pronounced effect upon the patient's symptoms.

Renewed X-ray control, 1—2 days after operation was carried out in altogether 57 patients, in 50 cases on one, in 7 cases on two or more occasions. An unchanged or only slightly changed lie of the contrast medium was observed in 53 instances. In 47 of these there was no shift at all, in 6 only a very inconsiderable one. In cases in which the ventricles had been opened by the incision lipiodol drops could be found on various places within the ventricular system. No harmful effect of the entrance of lipiodol into the ventricles has been observed.

In 4 cases renewed X-ray examination revealed a considerable shift of the contrast layer. In one of these the patient's clinical condition was still completely satisfactory. After another 24 hours no further shift had taken place and the patient, still entirely free of symptoms of intracranial expansion, was therefore discharged to a mental hospital on the third postoperative day. This case ran an entirely satisfactory course even subsequently. (Figures 1—2.)

In the remaining 3 cases intracerebral hematomas were verified in second stage operations. These cases shall be reported briefly.

Case 1. Nr 3783/47. Woman, 52 years. Bilateral frontal lobotomy was performed June 12, 1947. The anterior horn of the lateral ventricle was opened at least on the left side. Postoperative X-ray check showed a satisfactory position of the plane of section (Figure 3). On the 6th postoperative day the patient became more and more drowsy and on the following day she was comatous. The right pupil was dilated. The wound was opened up on the same day June 19th and a fairly large intracerebral clot was removed by suction. She cleared up considerably and was kept under observation in the neurosurgical ward until June 26 when she was discharged to a mental hospital. Already on the

following day she again became increasingly drowsy and was readmitted. X-ray examination revealed that the contrast layer on the left side was considerably dislocated with a backwards convex contour (Figure 4). In spite of the absence of clinical signs of a hematoma excepting her drowsiness and in spite her pulse and blood pressure remained unchanged she was operated on a third time on the ground of the X-ray findings. An intracerebral clot the size of a plum was found and removed. A little more than a week later the patient, however, succumbed. She never entirely cleared up from her semicomatous state.

Case 2. Nr 3957/48. Man, 28 years, suffering from schizophrenia. A bilateral lobotomy was undertaken on April 8, 1948. Postoperative X-ray check showed an ordinary lie of the contrast (Figure 5). During the following day the patient was restless and vomited repeatedly. Renewed X-ray control revealed a broadening of the lipiodol layer, still without any convex or bulging configuration. (Figure 6.) Excepting the pronounced restlessness of the patient no definite signs of intracranial hemorrhage were present, blood pressure and pulse rate being unchanged. The night after the second postoperative day his blood pressure rose from 120 to 160 mm Hg. A deviation of the eyes toward the right and a left hemiparesis with positive Babinski sign could be evidenced. Renewed X-ray control showed a still more increased broadening of the lipiodol layer on the right side. (Figure 7.) The wound was now opened up, the bony opening enlarged and a big clot under considerable pressure within the frontal lobe was removed by the sucker. The source of the hemorrhage was situated far mesially and consisted of a branch of the pericallosal artery which branch was clipped. The case at first seemed to take a favourable turn but on the third postoperative day an acute hepatitis developed with high fever and intense jaundice. The patient died June 14. At autopsy an acute septic hepatitis was found. In the right cerebral hemisphere were found remainders of a large hematoma which in medial direction had perforated into the rostrum corporis callosi (Figure 8).

Case 3. Nr. 6313/47. Woman, 43 years, operated on August 22, 1947 for mental illness with marked anesthetic symptoms. The operation had an uncomplicated course and the postoperative X-ray findings were normal. (Figure 9.) The patient was referred to a mental hospital on the following day. Renewed X-ray check had unfortunately been omitted in this case. A week later slight meningitic symptoms developed and the patient became increasingly drowsy. On September 5, a slight choking of the discs was observed and her right pupil was slightly dilated. For these reasons the patient was readmitted to the neurosurgical department. On readmission she was unconscious and had a markedly dilated right pupil. X-ray examination was now undertaken confirming the suspicion of a postoperative hematoma, since the lipiodol layer was seen to bulge markedly backwards. (Figure 10.) At reoperation a discolored hematoma evidently the seat of infection was evacuated with the sucker. The patient cleared up but a few days later she again became increasingly drowsy. By means of puncture pus was twice aspirated from the cavity and penicillin was given in full

dose locally and systemically. October 6. the patient could again be discharged to the psychiatric clinic. She was readmitted a third time five weeks later in a soporous condition. Pus could again be withdrawn from the cavity after blunt puncture of the wound. After repeated punctures and renewed penicillin treatment the patient could again be referred to the psychiatric clinic, from where she could finally be discharged on July 23. 1948 entirely relieved of her mental symptoms. She had spent the last twenty years practically uninterruptedly in mental asylums and hospitals.

Apart from the two fatalities reported above further 3 patients have died shortly after the intervention. In none of these a shift of the injected lipiodol was observed. One of these patients, a 65-year-old woman, displayed all signs of a postoperative hematoma only a few hours after the lobotomy operation had been finished. She was reoperated on in spite of negative X-ray findings. It was found that her hemorrhage was a spontaneous apoplexy within the internal capsule a good deal behind the lobotomy incision. These findings were verified at autopsy. A 45-year-old man operated on for a long-standing atypical facial neuralgia showed an unchanged lie of the injected lipiodol on two subsequent X-ray examinations. Six days later after having been referred to the psychiatric department he was unexpectedly found dead in his bed shortly after he had taken a heavy meal. At autopsy a general cerebral edema of a mild degree was found. The gyri were somewhat flattened and there were signs of a slight herniation both in the incisura tentorii and in the foramen magnum but no traces of a hematoma within the planes of section. The remaining case, finally, which had not been X-ray examined died on the 7th postoperative day from a massive hematuria. Autopsy revealed a severe hemorrhagic cystitis. A small amount of bloody fluid was found in the lateral ventricles but no hematoma in the lobotomy incisions.

In addition to these cases another 2 patients have died from pneumonia after readmission to mental hospitals. Death in both instances took place a considerable time after the operation and none of the cases had signs of hemorrhage within the field of operation.

Comments. The fatal outcome in several of the cases reported above should not dim the fact that lipiodol injection and repeated X-ray examination may serve as a valuable aid to the early diagnosis of post-operative intracerebral hematomas. A primary condition is, naturally, that no ill effects derive from the lipiodol in-



Fig. 1.



Fig. 2.

Figures 1—2: See text.



Fig. 3.



Fig. 4.

Figures 3—4: Case 1.



Fig. 7.



Fig. 6.

Figures 5—6—7: Case 2.



Fig. 5.



Fig. 8. Case 2. Autopsy findings.



Fig. 9.



Fig. 10.

Figures 9—10: Case 3.

jection itself. No such ill effects have been observed in a single one of our patients, not even in those cases in which lipiodol was seen to have entered the ventricular system. It is, however, of importance that every patient is tested before the operation for iodine idiosyncrasy. After our experience lipiodol is to be preferred to pantopaque. The latter substance has a tendency toward merging into larger drops in the lowermost portion of the incision whereas lipiodol is more liable to spread over the whole surface.

Especially in departments in which the lobotomy patients are kept for only a brief period of time X-ray check 24 hours after the intervention helps in abbreviating the period of immediate postoperative supervision. The vast majority of these patients can be discharged already on the day after the operation and only those cases which radiologically or clinically appear doubtful need to be kept for further control.

The radiological changes in cases with hematomas have been of two different kinds. Either has there been a bulging dislocation of the lipiodol layer outlining the contour of the hematoma as in figures 4 and 10 or has there been an entirely diffuse broadening of the contrast layer as in figures 2, 6 and 7. The former cases (Nrs 1 and 3) both ran a more prolonged clinical course and correspond to some degree to a case of chronic hematoma following lobotomy described in 1942 by FREEMAN & WATTS. This case is by the way one of the numbered cases of the literature in which this complication has been subjected to active surgery. The hematoma in this case was withdrawn by puncture, but in spite contrast had been injected apparently no X-ray control was undertaken.

Although one of our cases with radiological signs of a hematoma recovered without a second operation it seems advisable to revise the wound at the earliest possible stage in all suspected cases even if clinical localizing symptoms are missing. This attitude should at least be held in acute hematomas occurring within the first two days after operation. In number 2 of the above cases precious time was lost between the second and the third X-ray examinations mainly because the patient did not display any clinical signs of increased intracranial pressure except restlessness and vomiting. Pulse and blood pressure remained at an even level and the pupils were equal. If a sufficiently active attitude is held it seems possible to save at least some of the patients developing postoperative hematomas following lobotomy. Disregarding the

technique used such hematomas must be expected to develop at least in some small percentage after this operation. The fact that the surgeon — unwillingly enough — is the chief contributor to this complication must serve to increase his efforts not to leave any diagnostic or therapeutic opportunity untried to avoid a fatal outcome.

Conclusions. Lipiodol injected within the plane of section after frontal lobotomy has not been observed to exert any harmful effects even in cases where it has entered the ventricular system. If X-ray pictures are taken immediately after the intervention and furthermore after 24 hours an unchanged lie of the lipiodol in the second pictures proves that postoperative hematomas hardly need to be feared. A spread of the contrast in the control pictures may reveal a hematoma within the plane of section at an early stage. In such cases a second operation should be undertaken without delay.

Summary.

In a series of 99 frontal lobotomies iodized oil was injected within the plane of section in 94 of the cases. No untoward effects of the iodine contrast has been observed. Postoperative hematomas proved to cause typical and early changes in the lie of the contrast medium, either consisting in a bulging of the contrast layer visible in lateral X-ray pictures or in a diffusion or broadening of the contrast.

An unchanged lie of the lipiodol drops 24 hours after the operation seems to warrant that no postoperative oozing has taken place. The postoperative care of psychiatric cases in neurosurgical departments may thus as a rule be limited to 24 hours.

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Fractures of the Cervical Spine in Children.

By

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Fractures of the cervical spine are rather uncommon in children. These fractures, and particularly those of the cervical spine, present a number of problems especially from the therapeutical point of view. The literature hitherto published deals only with such fractures in adults and the viewpoints presented are not immediately applicable to a child clientèle. During the last years 4 cases of fractures of the cervical spine have been treated in the surgical department of the Gothenburg Children's Hospital, and as all of these cases with good results have been treated by a method which has not previously been described and which is especially expedient for children, the author has considered a report thereof justifiable, although the series is short.

Case Histories.

I. 3-year-old girl. *Diagnosis:* Fract. dent. epistroph. + fract. antibrachii sin. At a clash between a truck and a fire engine on Nov. 6, 1946, the patient was thrown to the ground. She was not run over. She had pain in the neck and the left arm. *Status:* Absence of pareses. Marked swelling of the back of the neck with pronounced evidence of pain on the slightest movement. The left lower arm is swollen and shows signs of fracture. Nov. 6, 1946. *Roentgen examination:* Fracture through the base of dens. Dens is displaced 3 to 4 millimeters anteriorly and there is a shortening of some millimeters. Hereby a luxation between atlas and epistropheus has ensued (C. J. HANSSON). — Nov. 13, 1946: Following the X-ray examination which revealed the fracture of dens the patient was placed in a dorsal position with hanging head.

She got on very well in this position. She reacted and cried when there was question of touching her head. Dec. 27, 1946. *Roentgen examination:* In the interval since the former X-ray examination the fracture of dens has healed. There is no malposition. Jan. 2, 1947. The patient has all the time been in bed without discomfort. She is now allowed to get up. She moves about freely but carries her head rather stiffly. She is given a wadding collar and light postural exercise treatment. Jan. 7, 1947. The patient is free from discomfort and is discharged.

II. 4-year-old boy. *Diagnosis:* Fractura dent. epistrophei. On April 18, 1947, the patient slipped on the hardwood floor. He sat down sharply on his buttocks and jerked his head. He has since then complained of tenderness in the nape of the neck, and has not been able to move his head. *Status:* The patient is recumbent with the head entirely fixated. There is pain on attempts to move. There is absence of pareses. — April 19, 1947. *Roentgen examination:* Fracture of the tip of dens epistrophei. The tip is displaced backwards, forming towards upper dens an angle which is open backwards. No other changes are observed within the cervical organs (G. ODEN). — April 22, 1947. The patient has been placed in a dorsal position with hanging head and was comfortable immediately in this position. He does not appear to be in any pain. *Roentgen examination* May 8, 1947. No malposition is observed. The fracture of dens now seems to be entirely healed (C. J. HANSSON). June 7, 1947. The patient has for some days been permitted to sit up in bed, and moves his head quite freely. He is discharged.

III. 9½-year-old girl. *Diagnosis:* Fract. vert. C II—III inveterata. Accident towards the end of June, 1947. The patient was playing in a lumberyard. She fell down, drawing the slabs of lumbar in her fall, and was hit by them in the back of her neck. She fainted. She was first seen at an infirmary, where a roentgen examination was carried out, without any fracture being discovered, wherefore she was sent home. She again sought medical advice as her neck still was stiff. Not either this physician was able to discover any skeletal damage. Two months later she again sought advice and was referred to this hospital. *Status:* In the upper cervical spine there is a shallow gibbus which is palpated better than it is seen. The head is extended forward and inclined to the left. There is total fixation (fig. 1 and 2).

Absence of pareses. Sept. 1, 1947. *Roentgen examination.* Luxation fracture of C II and C III with a forward displacement of the vertebral bodies and a subluxation position of C II in relation to C III and of C III in relation to C IV. No callus formation is demonstrable (C. J. HANSSON) (fig. 3). Sept. 5, 1947. *Roentgen examination:* The patient is placed in a dorsal position with hanging head and gets on comfortably in this position. Sept. 15, 1947. Unchanged picture of the fracture of the cervical spine. There is now only a luxation forwards of some millimeters of C II and a slight depression of the anterior edge of C III (C. J. HANSSON) (fig. 5). Sept. 16, 1947. The luxation seems to be nearly raised. The deformation, however, of the vertebral bodies still



Fig. 1.



Fig. 2.

Fig. 1—2. Case 3. 2 months old inveterated luxation fracture of C II and C III.

remains, and it is considered questionable whether the good repositioning may be maintained in the future, in view of the long interval since the occurrence of the fracture. The advisability of performing an Albee operation and inserting a bone graft into the processes of C II, C III and C IV is deliberated. In preparation of this a plaster cradle is prepared, extending on the volar side from the chin down over the neck and chest. After application of the bandage the patient is placed in a prone position. It is now revealed that the patient is able to bend her neck backwards and to turn her head freely to both sides. Because of this it is considered that the Albee operation may be postponed, the musculature of the neck being exercised instead, pending the conversion of the cervical vertebrae. The patient is for the present to remain in a dorsal position with hanging head. Oct. 14, 1947 *Roentgen examination*: At examination of the cervical spine with the patient in



Fig. 4. Case 3. The luxation raised after 16 days of treatment with hanging head.

a sitting position no marked malposition is demonstrable. There is merely a slight displacement volarly of the second vertebra in relation to the third (C. J. HANSSON). Nov. 3, 1947. The patient is provided with a plaster collar embracing the anterior aspect of the neck and supporting the chin, while resting on the shoulders and against the front of the chest. The patient is treated with postural exercise therapy and heat lamp. Nov. 31, 1947. *Roentgen examination*: No malposition is now demonstrable within the upper cervical spine. On movement of the cervical spine there is possibly a rather larger displacement between C II and C III at inclination of the head (C. J. HANSSON) (fig. 6). The motility of the neck is excellent in all directions. The plaster collar is to be continued for another 6 months. The patient is discharged. — At dispensary check-up the motility remained unchanged. The patient was permitted to remove the plaster little by little. The support was entirely removed after 6 months. The patient was discharged cured.

IV. 15-year-old boy. *Diagnosis*: Fract. vertebrae C IV. While bathing the patient dived and hit his head on the bottom of the swimming pool. He became dazed but did not faint. He was unable to move his neck and had to be taken home in an automobile. The following day he was admitted to this surgical department. *Status*: There is no deformation of the neck. The neck is kept fixed. The patient reports pain on attempts to move the neck. Oct. 23, 1946. *Roentgen examination*: Compression fracture of C VI. The upper area is compressed. There is a slight compression fracture of C IV. There is also luxation posteriorly about $\frac{1}{2}$ cm of the cervical spine in relation to C VII (C. J. HANSSON). Nov. 22, 1946: The patient has since admission been treated with bed rest with hanging head. Subjectively he is free from discomfort. Dec. 5, 1946. *Roentgen examination*: Good position of the vertebral fracture (C. J. HANSSON). Dec. 21, 1946. The patient has been sitting up for 4 days. There is good motility of the neck, which, however, is fixed with a cardboard collar. He is discharged. At a subsequent check-up the patient is seen to be entirely free from discomfort.

Material.

The series comprises 4 cases: 2 boys and 2 girls. The age distribution was: 3-year-old girl, 4-year-old boy, $9\frac{1}{2}$ -year-old girl and 15-year-old boy.

Localization.

The two youngest patients showed fractures of dens epistrophei. One of them (case 1) had a fracture through the base of dens, which was displaced 3 to 4 millimeters forwards, whereby a subluxation position between atlas and epistropheus occurred.

The other dens epistrophei fracture (case 2) was close to the tip of dens. The tip was somewhat displaced backwards, comprising towards upper dens an angle open backwards.

The girl of 9½ had an inveterated luxation fracture of C II and C III with sliding forward of the vertebral bodies and a subluxation position of C II in relation to C III and of C III in relation to C IV (fig. 3).

The oldest boy (case 4) had a comparison fracture of C VI and C VII as well as a subluxation position posteriorly of C VI.

Origin of Trauma.

In one case the fracture of dens epistrophei was caused by indirect trauma (case 2). The patient had slipped on the floor, sitting down backwards with stiff legs, whereby his head had jerked violently. The patient complained of pain in the nape of the neck and was unable to move his head. *This origin of a dens epistrophei fracture has not previously been described and may also be of forensic interest.*

In the remainder of the cases the fractures occurred by direct trauma. In case 1 the fracture occurred in an automobile accident, a crash between a truck and a fire engine, whereby the patient was thrown to the ground. In case 3 the patient had 2 months before admission been playing in a storage yard for wooden slabs. These tumbled down, knocking the patient down, whereby she was hit by one or several slabs in the nape of her neck. In case 4 the fracture had occurred while bathing when the patient in diving struck his head against the bottom of the pool.

In none of these cases was the fracture of the cervical spine associated with pareses.

Treatment.

The usual method of treating fractures of the cervical spine is to apply a Glisson's sling and then weight this with an extension apparatus. Everyone who has used Glisson's sling knows that it is an extremely painful and inefficacious instrument. The pressure is namely directed towards the chin and the lower edge of the mandible, which are very sensitive to pain and which easily become the seat of decubitus on pronounced pressure.



Fig. 3. Case 3. Inveterated luxation fracture of C II and C III.



Fig. 6. Case 3. No luxation but still a certain compression of the anterior edge of C III and C IV. Plate taken in the standing position.



Fig. 5. Case 3. Position of patient in bed with hanging head. It is convenient to have a narrow sandbag at each side in order to prevent turning to the side.

In order to avoid pressure on the mandible though still giving a possibility of extension CRUTCHFIELD has devised an extension bow which instead is applied as a nail extension in the cranium. Both of these methods of extension suffer from the primary drawback that the traction is exerted in the longitudinal direction of the spine. As vertebral fractures in the great majority of the cases are volar greenstick fractures — with compression anteriorly of the vertebral body and possibly a rupture of ligamentum interspinosum posteriorly —, a longitudinal extension does not bring about a reposition of the fracture or of the condition of luxation occasioned thereby. BÖHLER was the first to consistently adopt a repositioning of vertebral fractures by dorsal overextension by means of suspension in a sling. This repositioning is done under local anaesthesia and the fracture is subsequently fixed by means of a plaster brace, after which a prolonged postural exercise therapy is begun. This method introduced by BÖHLER has in suitable cases given extremely good results, especially in the case of fractures of the lumbar and of the thoracic spine in young and muscular individuals. The method, however, has not been equally convincing in the case of fractures in children and elderly obese individuals, or when the fractures have been localized within the upper cervical spine.

When children are concerned one strives to adopt methods of treatment that are as simple and painless as possible while at the same time affording a reliable fixation. As mentioned above, the BÖHLER method in fractures of the cervical spine involves a suspension in Glisson's sling under local anaesthesia and subsequently of a plaster collar, all of which is difficult when young children are concerned.

The cases described in this report have instead been treated with bed-rest, the patients in a dorsal position with the head hanging down freely (fig. 4). During childhood the weight of the head constitutes quite a large percentage of the entire body weight. This weight will thus in these cases act in a direction that promotes the reposition of an existent luxation or compression (see fig. 3, 5 and 6). This arrangement, which may be built up with wedge-shaped bolsters, bed-rests, etc., does not necessitate the acquisition of any extra apparatus. It is often expedient to raise the foot of the bed so that the patient does not glide down. The head is supported on both sides with a narrow sand-bag. It is striking how the patients immediately feel

free from discomfort on being placed in this position. The feeding problem does not present any difficulties. Fluids are taken through a glass tube. Older children are often entertained by having a mirror over their bed, which they themselves can adjust and in which they can observe what is going on in the ward.

Summary.

The author reports 4 cases of fractures of the cervical spine in children. One of these fractures (of dens epistrophei) was caused by indirect trauma. One of the fractures was an inveterated luxation fracture. All of these cases were treated with bed rest with a freely hanging head, this treatment in all of the cases resulting in a good reposition and giving total freedom from discomfort.

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Some Problems Concerning the Herniated Intervertebral Disk from a Clinical Point of View.

By

STIG LINDGREN.

For the correct interpretation of the condition of herniated intervertebral disk it is essential to recognize that the disk herniation merely is a specific case of an injured intervertebral disk. The degenerated disk gives rise to clinical manifestations of lumbar insufficiency, probably mainly due to instability, and pressure from the disk on pain-perceptive organs, above all in the longitudinal ligaments. The disk herniation obtains clinical importance when the sequestered nucleous substance pressed through the ruptured annulus fibrosus comes into contact with some spinal root, compressing this mechanically. Such a mechanical root compression may arise in degeneration of the disk also in the absence of herniation, but this is far less common. A removal of the herniation is therefore in the first hand directed towards relieving the patient from the root symptoms, the sciatic pain, while the therapy directed towards the disk degeneration in so far that this gives rise to clinical manifestations, has the object of increasing the stability between the vertebral bodies.

In the following are discussed a number of viewpoints on herniated intervertebral disk, mainly with regard to the clinical diagnosis and localization of the root, the operative technic, and the results. The study is based on a series of 500 surgically treated verified cases of disk herniation, all except 6 operated by the author.

The Diagnosis.

The typical case history in herniated intervertebral disk debuts with periods of low back pain, which must be considered an expression of the progressing degeneration of the disk and the formation of fissures in annulus fibrosus. Gradually root symptoms supervene, in some instances already after a few days of back pain, sometimes even without preceding back pain, with pain and radiations down into the leg; this must be interpreted as the expression of a disk prolapse having migrated and come into contact with a lumbar root. The pains vary in duration and intensity, being sometimes of short duration and transient, but more commonly intermittent with varying intervals. At times the pain is permanent and of many years duration. The symptoms are commonly augmented on movement and exertion of the back with exacerbation on coughing and sneezing, on pressure and percussion of the back as well as on attempts to correct a malposition. A further distinguishing characteristic is the segmented radiation of the pains, the paresthesias and the feeling of numbness.

Bilateral symptoms are uncommon, with the exception of insignificant paresthesias radiating towards the opposite hip. Identical bilateral symptoms seem to speak against disk herniation. It is thus only rarely that a disk herniation migrates in the midline, because of the strong posterior longitudinal ligament running here. Not until this tapers off laterally in the vertebral canal does the disk herniation find its way out. Such identical and bilateral symptoms rather suggest a disk degeneration with absence of herniation.

Occasionally the history includes reports of attacks of sciatica sometimes on one side and sometimes in the other. This may be the expression of bilateral disk herniation from the same disk, but this is a rare condition. Commonly the sciatic pain oscillating from side to side is the expression of a disk degeneration without herniation. Gradually, however, the symptoms usually become fixed to one leg, with more severe discomfort than ever previously, and in this case a disk herniation has in all probability finally protruded on this side.

The dorsolumbar region often shows characteristic changes in the form of straightening and scoliosis. The normal lumbar lordosis

may even be reversed to kyphosis of the dorsolumbar region. The scoliotic position can be extreme but is equally often lacking. It is commonly the hip of the affected side that protrudes but this does not occur regularly. This distortion is the expression of an instinctive compensatory correction, the patient instinctively choosing a posture in which the pressure of the disk herniation on the nerve root is the least possible. In young patients with their greater suppleness and elasticity the malposition is found more frequently and is often very pronounced, while the back of the older individual does not have the ability of assuming such distorted positions. In attempts toward correction of the skewness the patient often reacts with increased pain from the leg. It is therefore hardly rational, in cases of herniated disk scoliosis, to direct the therapy towards a correction of the back by a plaster of Paris bed, or similar measures, without first having removed the fundamental cause, the disk herniation.

In our series the lumbar back has been normal in appearance in 15 per cent, slightly straightened in 38 per cent, straightened in 40 per cent, and kyphosed in 6 per cent of the cases. Increased lordosis has only been found in 1 per cent of the cases. Scolioses were found in 55 per cent.

On examination of the patient *ad modum* Lasègue there occurs a stretching of the nerve which increases the pressure between this and the herniation. This stretching which leads backwards into the spinal canal may easily be observed at operation if Lasègue's test is made after exposure of the nerve root. It is then seen how this is still more tightened and squeezed against the disk herniation. A sciatica caused by an intervertebral disk herniation with a negative Lasègués sign is, as appears from table 1, extremely uncommon.

Table 1.
Lasègue's sign in disk herniation.

At 20°	17 %
» 30°	18 %
» 40°	19 %
» 50°	13 %
» 60°	16 %
» 70°	9 %
» 80°	4 %
» 90°	4 %

Which root is involved, or in other words, in which interstice the herniation is to be found, may with fairly great certainty be determined by analysis of the segmental neurological symptoms. The S I and L V symptoms, mainly elucidated by NORLÉN, usually afford a possibility of distinct diagnosis. Of especial value hereby is the patient's localization of the paresthesias and numbness, furthermore the disturbance of the Achilles reflex and the great toe power. It is furthermore of major importance that there in clinical practice commonly has to be taken into account the two lower disks only. Out of our 500 cases only 5 have been localized to another lumbar disk. The lumbosacral disk has hereby in 60 per cent been the origin, the disk above this in 40 per cent of the cases.

Table 2.

The distribution of pains, paresthesias, pareses and reflex-disturbances in % of our last 300 cases.

	Herniation from the lumbosacral disk (184 cases)	Herniation from the L IV—L V disk (116 cases)
<i>Distribution of pains, paresthesias</i>		
not below ankle	32 %	20 %
little toe, outside and below the foot, heel	62 %	6 %
great toe, dorsum of foot	6 %	74 %
<i>Great toe power</i>		
paresis	14 %	80 %
<i>Ankle jerk</i>		
absent	55 %	4 %
diminished	30 %	21 %
normal	15 %	75 %

Table 2 shows the distribution of the root symptoms in herniation from the lumbosacral disk and from the disk L IV—L V. It is, inter alia, seen how very rarely the Achilles reflex is absent in herniation originating from the disk L IV—L V. The paresis of the great toe is somewhat more common in herniation from the lumbosacral disk. In 25 per cent of the cases the patient denies the occurrence of paresthesias below the ankle, which appreciably reduces the possibilities of a differentiation between the roots.

In practice the result is that we with this *neurological root diagnosis* in 75 per cent of the cases at operation have found the

herniation at the interstice anticipated, while we in the remaining 25 per cent have had to explore more than one interstice before finding the herniation. This miscalculation may to a certain extent be due to an error in orientation at operation, in some cases due to a sacralization or lumbarization of the lower vertebrae, and to some extent to the fact that the herniation at first was not identified in the correct interstice and exploration continued to another interstice. Herniation from the disk L IV—L V may always be considered to involve the S I root also, if it is developed medially, although, as appears from the tabulation, it is by no means very common to find S I symptoms in disk herniation from the L IV—L V disk. The reverse is just as common. The majority of unsuccessful explorations are due to the fact that the symptoms have not clearly enough suggested the L V or S I syndromes, this often being the case when the paresthesias do not involve the foot. In several cases, however, the symptoms have not been true to pattern.

The following case of recidivated disk herniation affords an interesting illustration to the development of paresis of the great toe in herniation from the lumbosacral disk.

A 32-year-old man was after 6 months of continuous pain operated on for a disk herniation from the lumbosacral disk. He had at that time typical root symptoms with absence of the Achilles reflex, but no paresis. The herniation bulged in, about the size of a pea, and after incision of the capsule masses of sequestered substance emerged. He soon became free from symptoms, a numbness of the little toe remained but this also faded. 3 years later he had an acute onset of extreme sciatic pain from the posterior aspect of the thigh down to the great toe. After 3 days of severe pain the outer aspect of the thigh became numb and the dorsum of the foot and the great toe felt weak. There was a reduction of sensitivity over the 4 medial toes (not the little toe!), the dorsum of the foot and the outer aspect of the calf, and also a very marked paresis of the great toe, which hung down flaccid. The power of the Achilles group of muscles was also reduced although not as markedly as the paresis of the great toe, and the Achilles reflex was absent. Disk herniation from L IV—L V was naturally suspected but at operation this as well as L III—L IV and L II to L III, which all were explored, were found to reveal nothing pathological. Finally the herniation was identified; again originating from the lumbosacral disk laterally between annulus fibrosus and sacrum it had followed the S I root down into the root canal; it was the size of a bean and not covered by ligament. The S I root was reddened and edematously swollen. With inlaying indicator the height was checked roentgenologically. There was no possibility of the herniation coming

into contact with the L V root. The paresis has slowly receded but is still manifest, 2 years postoperatively.

Multiple herniations giving rise to symptoms are infrequent. Out of our 500 cases we have operated upon only 11 such cases. It should in this connection be noted that only in one case have 2 herniations in different sites of the disk been removed at the primary operation. The remaining 10 have subsequently been affected with new symptoms of sciatica, whereby disk herniations from other origins than the first have been extirpated, in 5 cases from the opposite side of the same disk. In a further number of cases the patients have later shown symptoms that have afforded clinical suspicion of disk herniation from another root, but the symptoms have been so mild that they have not required operative intervention. These cases are but few in number and as our series, as reported below, has been followed regularly and the patients in 96 per cent have been traced, it is justifiable to assume that no appreciable number of such cases has been un-diagnosed. Myelographic studies published from other quarters indicate a considerably greater occurrence of multiple disk herniations. This discrepancy should be explained by the fact that a disk herniation which *e. g.* has been myelographically established does not always give rise to clinical symptoms. One need therefore in operations for disk herniation rarely apprehend that the patient has more than one herniation causing symptoms.

Roentgenological examination of the dorsolumbar region affords valuable information as to the occurrence of a degeneration of the disk with instability and displacements, decreased intervertebral distance, sclerosis and exostoses but is only of trivial value for the diagnosis of the disk herniation. Analyses of the relation of the rupture on bending sideways are not either of practical clinical value. Myelography, on the other hand, is a valuable means of diagnosis, the positive contrast medium, owing to its sharper outlines, hereby being preferable to the air or oxygen myelographies. A myelography, however, is by no means inoffensive or without risk for the patient. The reaction to pain with the positive contrast media is so intense that spinal anesthesia always must be given. In spite of this the patients not infrequently during the 24 hours after the examination complain of discomfort. RIBBING, in a paper read before the Swedish Radiological Association in 1947 has described our experiences hereby. In no less than

3 cases we have experienced that the patients have been subject to severe epileptiform attacks after this procedure.

These attacks have had the following course:

A 22-year-old woman, previously healthy, had after 4 to 5 years of mild lumbar symptoms for 6 months had continuous root symptoms, paresthesias, Lasègue 30° and diminished Achilles reflex. Myelography was done, however, with positive contrast (contrast U). 2 hours later she according to her own description had "electric" prickings in arms and legs, felt instability of the hands and was unable to hold a glass of water, after which she "fell asleep". The attendants observed that she was restless, she looked hot and perspiring and turned and twisted in bed. She denied headache or other pains. After from 5 to 10 minutes of these prodromes there occur epileptiform cramps, tonic and clonic cramps in both arms, a vacant gaze, short and rapid respiration, and there is twitching of the entire body which is bent backwards in the opisthotonic position. There is bluish pallor of the face. The attack recedes and her condition improves. Babinski positive bilaterally. After the lapse of a few hours she states that she feels quite well except to a slight headache. The Babinski reaction remains positive on the right — healthy — leg until the following day. No disk herniation was demonstrable at myelography but a few months later a diffusely protruding herniation the size of a hazel-nut was removed from under the S I root.

It is to be hoped that improved contrast media will lessen or entirely eliminate such symptoms of irritation.

As the myelography must be combined with spinal anesthesia and as this intervention in itself is associated with a rather high percentage of complications, the indication for myelography should be kept restricted already for this reason, and furthermore so with consideration to the irritant effect of the contrast medium. In other words, it is in our opinion not justifiable to use the myelography as a routine examination in suspected cases of disk herniation, but to reserve this measure for cases in which the clinical neurologic symptoms are difficult to interpret. In those cases in which the diagnosis of disk herniation and the indication for operation seem clear-cut, but in which the root localization is uncertain, it must be considered less harmful to the patient if the surgeon is compelled to explore more than one root than to make a myelographic study. A factor that further limits the value of myelography is that in a to all appearance normal myelography there still can be a herniated disk. This is easily explicable for anatomical reasons and the author has even in some instances operatively removed disk herniations which it has not been possible to establish myelographically.

Operative Technic.

In order to obtain good operative results in intervertebral herniated disk a good and meticulous operative technic is as always of the utmost importance, so that the intervention does not cause secondary discomfort.

Local and spinal anesthesia have alternately been used. The latter has advantages in the muscular relaxation which facilitates the operation but which carries the usual drawbacks of spinal anesthesia. The prone position is preferable to the lateral position and the patient is so placed that the dorsolumbar region is kyphosed to the furthest possible extent. We place the patient on a specially constructed rounded support, which has a cut out for the abdomen, somewhat larger than the "porridge bowl" in a plaster brace, this because a firm pressure towards the abdominal wall augments the stasis of the veins of the spinal canal. The spinous processes are left intact. A removal of the spinous processes augments the instability and decreases the possibilities of stabilizing interventions. The musculature is bluntly pushed aside so that the arches become exposed. If a roentgen indicator is not used, localization is obtained by following the posterior side of sacrum with the finger, until the lowest interstice and the arch of L V, are encountered. After localization of the interstice involved, one-half centimeter of the rounded lower border of the upper arch is removed by means of a gouging forceps. Ligamentum flavum may then be grasped with a tenaculum forceps and is resected from the arches with a slender knife, so that a rectangular aperture, about 1—2 centimeters in diameter is obtained. It is frequently necessary to widen the aperture distally by removing the proximal sharp margin of the lower arch and following the nerve a short distance down into the intervertebral canal. A punch is well suited for this purpose. There is here frequently very limited space as the herniation presses the nerve root firmly against the posterior wall of the spinal canal. The nerve root and the disk herniation lie far lateral in the spinal canal and it is for exposure often necessary to extirpate the laterally overhanging bone with a chisel. This lateral widening of the surgical incision seems to us to be of major importance. Exposure of the nerve is obtained, its lateral margin is seen and with an

elevator the nerve is retracted medially, whereby the herniation is exposed. It more infrequently occurs that the herniation appears in the angle between the dural sac and the nerve root, so that the herniation lies medial to the nerve. Occasionally the herniation lies uncovered without protection of the ligament, in other cases it is covered by a thin layer of ligament which then is incised by means of a knife whereby the compressed sequestered masses commonly well forth. The neck of the herniation is in some cases found between annulus fibrosus and the lower vertebral body, in other cases between the ligament and the upper vertebral body, sometimes medially in annulus. As mentioned above the hernial canal is hardly ever found in the midline because of the powerful posterior longitudinal ligament, the herniation instead migrating to the site where this ligament tapers off at the side. Not infrequently the disk herniation in the form of an extrusion follows the root into the intervertebral canal in a very lateral position. But if one only, as already pointed out, chisels the bone off laterally there is little danger of overlooking a herniation in such a localization. The largest and most troublesome veins run in a plexus anteriorly and laterally in the spinal canal and require great attention. Bleeding here is best controlled with diathermy or compression. Adequate illumination and suction are indispensable.

In those cases in which there is found an entirely loose sequestration with a fissured empty hernial canal there hardly seems to be reason to do more than to remove the sequestration. In other cases in which the herniation is more diffusely protruded and the sequestered masses are not entirely superseded but continue into the center of the disk with fibrous threads the center also should be scooped out. The risk of reeidivation will otherwise be great. With suitable instruments, polyp forceps of the type used by otologists, Riesslers eurette, and so forth, one attempts to evacuate the cavity as far as possible. The anatomical construction of the disk makes this extremely difficult, not to say impracticable, but it should, however, be feasible to evacuate the necrotic center of the disk. This should obviously be done with the greatest caution, cases have been reported in which at this intervention aorta was perforated! The walls of the herniated canal are eventually smoothed with a knife.

There is no adequate way of preventing a reeidivation from issuing from the open canal by sealing this up.

An exact hemostasis must be considered of major importance. A large coagulum which settles around the root and the dura may with certainty give rise to secondary discomfort. An adequate hemostasis must be ensured with patience. Drainage for the bleeding is in our opinion to be contra-indicated as it hereby is not possible to avoid the occurrence of massive coagula around the nerve. We incessantly wash the wound cavity with physiological saline solution and fill it on closure with the same solution, this also for the prevention of massive coagula.

We not infrequently combine an intervention for the purpose of stabilization, with the extirpation of the hernia. This is done in those cases in which it is found that a vertebral body, usually L IV or L V, is pathologically unstable and easily is moved backwards and forwards on being grasped by the spinous process. A simple measure hereby is to chisel a groove in the spinous process. At the same time thin bone chips are chiselled off in such a manner that they form a bridge over from the one spinous process groove to the next. The bone chips obtained from the border of the arch are utilized for the same purpose. No other form of primary osteosynthesis with grafts from tibia or the iliac crest has been carried out in the extirpation of disk herniation. (In 3 cases of the present series such operations have been done secondarily and are described in the following.)

Unless postspinal discomfort prevents, a policy of early ambulation is followed and already on the third postoperative day the majority of the patients are out of bed. The back pains may, however, necessitate a prolonged bed rest and eventually a plaster cast or a brace as described in the following.

One week following operation treatment with postural exercise, hot baths and Finnish baths is instituted. With regard to the postural exercises the author considers it of major importance not to force the patient to bending forwards or to rotate the trunk, the treatment rather having the object of bracing the dorsal musculature. The patient is encouraged to frequently take the prone position and to practice raising shoulders and legs backwards so that the back is arched. The patient is hereby trained in keeping his back erect and the disastrous tendency to slouch is counteracted. It is better for the patient to have a straight, strong and painless back than to have a soft and tender one. The treatment is analogous with that used in cases of tuberculous spondylitis with destruction of the vertebrae.

Results.

The immediate result of the extirpation of the disk herniation usually is followed by a dramatic change for the better, the sciatic pain has vanished into thin air, the patients are out of bed already during the first week and are generally discharged within 2 to 3 weeks postoperatively. (Cf. table 3.) The nature of the postoperative course is in a way characterized by the postoperative period of treatment.

Table 3.

Period of hospitalization following operation for herniated intervertebral disk.

About 2 weeks	71 %
» 3 »	17 %
» 4 »	5 %
» 5 »	1 %
» 6 »	2 %
» 7 »	1 %
» 8 »	2 %
» 10 »	1 %

In some cases pain and paresthesias in the leg remain for one or more weeks. It looks as though this mainly were caused by the nerve during operation having been injured by being pushed aside in order to expose the herniation. Great caution is therefore of importance in doing this. The importance of a meticulous hemostasis has already been stressed.

Immediate postoperative back pain is encountered occasionally, although it is surprising to see how little discomfort most patients have from their back. In mild cases there is stiffness and contractions but the patients limber up within the course of a few weeks. Others again have a tendency towards scoliotic postures. It has already been pointed out how common the scolioses are preoperatively, owing to the compensatory posture. Most of the patients straighten up without further treatment than the extirpation of the disk herniation. Some few patients require specific treatment because of skewness, pain and a feeling of weakness. The most effective treatment hereby is to place them in a plaster of Paris cradle and then eventually in a plaster and paper brace.

As stressed above the extirpation of herniated intervertebral disk often is combined with an intervention with the object of stabilization, this in such cases in which there at operation is observed an unstable vertebra. These cases are not given the routine treatment with splints or plaster cradle, this latter therapy being resorted to only in cases where the patient on being made ambulatory has subjective symptoms from his back.

Some few cases have had painful cramps in the back, radiating ventrally, these cramps being provoked even by the slightest movement. A couple of patients have had extremely painful cramps, in one case lasting for 6 weeks. Treatment with plaster cradle was hereby resorted to.

The most severe case of this type is described below.

A 35-year-old woman with an anamnesis of 9 months standing; initially back pains, then by degrees increasingly dominating right-sided sciatic pain with a number of symptoms in the left thigh, a stiff back, considerable pain on percussion, bilateral Lasègue's sign 60 to 70°, absence of the right Achilles reflex. The herniation was rather larger than a hazel-nut and sited unusually far medially, so that the S I root was compressed lateral to the herniation. There was a broad prolapse with fibrous masses down to the center of the disk, which was evacuated. L V was unstable wherefore a modified Albee operation L IV, L V—sacrum was performed. One week postoperatively, in connection with a fall from a chair, the patient had severe cramping pains in the back and down into both legs. She tried to lie perfectly immobile as she on the slightest movement was attacked by the cramps, whereby she placed herself in an opisthotonic position. The pain did not recede until the patient was placed in a plaster of Paris cradle. She was discharged 10 weeks postoperatively with a firm brace which she had for one month. There was a rapid improvement and she did not use a corset after a few months, and has a very mild residue dorsal insufficiency with hardly perceptible symptoms from the legs. The violent phenomena of excitation were probably due to the unstable disk.

In 4 per cent of the cases we have postoperatively employed a cradle and one-half of these cases have subsequently received a plaster and paper corset. 2 per cent of the patients have without first having had the cradle treatment received such a paper brace. We have, however, more commonly prescribed an ordinary fabric corset with bones for the immediate postoperative period, this in 8 per cent of the cases.

Among other uncommon complications are noted 2 cases of spinal-fluid cyst that have occurred following overlooked dural lesions and that have called for secondary interventions.

The late results appear from the results of the follow up examination in table 4.

Table 4.

Follow-up examination of 375 cases of surgically treated disk herniation 1½ to 6 years postoperatively.

<i>Symptoms from the leg.</i>		
Free from symptoms	216	58 %
Casual and slight cramps, shooting pains, numbness, paresthesias	102	27 %
Recidivations, operated free from pain after secondary intervention	21}	7 %
residue discomfort	4}	
Probable recidivation, transient symptoms improved without operation	12	3 %
Symptoms of new herniation from another origin operated	11}	5 %
non-operated, slight and transient	9}	
<i>Symptoms from the back.</i>		
Free from symptoms	198	53 %
Slight symptoms, stiffness, pain following heavy labor	148	39 %
Marked symptoms	29	8 %
<i>Subjective opinion of the patients on the efficacy of the operation.</i>		
Very beneficial	303	81 %
Quite beneficial	59	16 %
Questionable improvement	11}	3 %
Deterioration	2}	

The cases are followed regularly, some of the patients presenting themselves for examination, others at intervals of from 6 months to 1 year reporting on their condition by mail. If no information is received a questionnaire is sent. For the period reported in the table 96 per cent of the surgically treated patients have been traced, wherefore the result is unknown in only 4 per cent of the cases.

There is, however, no reason to assume that there among these 4 per cent should be an accumulation of "failures", the contrary being more likely.

There have in 7 per cent of the cases occurred recidivations that have been subjected to secondary operations. Among these, 21 cases have recovered following re-operation, while 4 cases have persistent residue pain. Not less than one-half of the recidivations have occurred within 3 weeks after the primary operation and this should probably be interpreted as an expression of the fact that the evacuation of the sequestered substance has not been suffi-

ciently effective. The frequency of the recidivation seems also to have decreased in recent years.

There are furthermore 3 per cent of suspected recidivations, the patient again being affected with sciatic symptoms with signs of involvement of the same root. The pain, however, has been mild and transient, and has in most of the cases not called for hospitalization, re-operation not having been deemed necessary.

In 5 cases (1 per cent) herniations have later originated from the same disk although on the other side and through a new neck, and these have been surgically removed. In 7 further cases ($1\frac{1}{2}$ per cent) there has been clinical suspicion of the same diagnosis but the discomfort has disappeared after a conservative therapy.

New disk herniations from other disks have in 6 cases been extirpated ($1\frac{1}{2}$ per cent) and there has in 2 further cases been clinical suspicion of the same condition.

In regards to the back pain the patients complain to a somewhat greater extent of residue back pain than of such symptoms from the legs. It is, however, if anything surprising that there is not residue back pain in more of the cases, since the herniation is the result of a diseased disk. Since practically all of the herniated disk patients have had longer or shorter periods of back pain prior to operation the frequency of back pain is thus considerably decreased following operation (cf. table 4).

It may generally be considered that the more prolonged and severe the back pain has been before the appearance of the root symptoms, the greater is the probability that the back symptoms will remain after operation and after the disappearance of the sciatic symptoms.

As pointed out above the author frequently combines the extirpation of the disk herniation with a stabilizing intervention *ad modum* Albee, although only by laminating the spinous processes with the insertion of bone chips. The indication for this is an instability demonstrated at operation. The author has at present no possibility of statistically establishing the effect of the intervention for the purpose of stabilization, unless the relatively low number of persistent and mainly of persistent *severe* back pain, is accepted as an interpretation thereof.

There was above reported the number of cases that in immediate association to the operation were placed in a plaster cradle and that received a firm corset. This brace has in nearly all of the cases been removed after some months. Certain cases, however,

must also use the brace in the late course. Usually they resort to this corset, of fabric with bones, on the occurrence of back pain or of attacks of lumbago. Only a couple of the patients use the corset permanently.

In 2 cases there has because of severe back pain been performed a secondary stabilizing operation with bone grafts from tibia or the iliac crest, the operation being successful in both instances. In a third case this operation was performed elsewhere.

In some of the cases with persistent severe postoperative back pain there is observed a narrowing of the disk.

A 42-year-old woman with a classical L V syndrome and paresis of the great toe had a free sequestration the size of a bean originating from the disk L IV—L V. A moderate amount of necrotic substance was evacuated from the center of the disk. The vertebrae did not appear to be unstable. The preoperative course was at first smooth and the patient was discharged free from discomfort after 2 weeks. In association with a long railway trip some days after discharge she had back pain, became markedly scoliotic and began to have neuralgic pain in the opposite leg. She was re-admitted 10 weeks postoperatively. The subjective symptoms were in regression. She was still scoliotic and had mild root symptoms from the leg of the non-operated side indicating that the L V root was involved. The paresis of the great toe had disappeared, no weakness was established on either side. Roentgen examination showed that the distance between the vertebrae had diminished from 15 millimeters to 12 millimeters. When the subjective symptoms were in distinct regression postural exercise treatment was instituted and 5 months following operation she was free from discomfort and the configuration of the back was normal. The distance between the vertebral bodies has during a further year of observation not been changed and the patient has been free from symptoms.

A similar depression of the disk has only exceptionally been observed; the series, however, has only to a certain extent been checked roentgenologically. One questions whether possibly a too radical evacuation of the disk center may give rise to such a depression of the disk as in the case described above. When the nucleus pulposus substance is degenerated and partly sequestered it can hardly be of importance for the maintenance of the distance between the disks. This is thus surely physiologically largely dependent on the powerful annulus fibrosus. If in evacuation of the center of the disk vital annulus fibrosus substance should be removed there is surely a risk of diminishing the power thereof, this resulting in increased instability and narrowing of the disk. This should be borne in mind in evacuation of the center of the disk.

Stabilizing operations with free bone grafts have, on the other hand often been carried out in cases of severe and protracted dorsal insufficiency in which there has not been signs of herniated intervertebral disk. During the period of treatment of the present series of disk herniation, 44 such bone-grafting operations have been carried out. If this operation succeeds so that the transplant heals in and stability is obtained the result is very satisfactory.

In one case a disk herniation has developed following an "Albee"-operation.

A 44-year-old man with back pain of 20 years standing frequent episodes of lumbago type with prolonged confinement to bed, repeated treatments with plaster braces and so forth. No radiation to the legs. Roentgenological examination shows very slight changes with somewhat decreased distance between the disks. Air myelography shows a very slight protrusion from L IV—L V. A fixation operation, with 15 centimeter long bridges from tibia placed on the vertebral arches from sacrum to L III, was performed. The L V was rather loose. The patient was postoperatively well and had not lumbago attacks or other symptoms for 2 years, but was after this lapse of time taken ill with a period of violent coughing with left-sided neuralgias of L V type, and a mild great toe paresis. As the symptoms persisted despite a protracted conservative treatment the L IV—L V interstice was explored and hereby was found a protrusion of the disk the size of a pea, posterior to the L V root and after incision to the ligament the entire sequestered nucleus was extirpated. The later course has since then been calm.

Cases Explored for Suspected Herniation, Without this Being Established.

A discussion of the disease of herniated intervertebral disk is incomplete without an analysis of the cases that showed symptoms giving rise to a suspicion of herniation but in which no herniation was demonstrable at operation. These cases are not uncommon. During the same period in which we operated and removed 500 herniated disks 96 cases, thus 16 per cent of the series, were such "negative cases". In other words, at approximately every sixth exploration no herniation of the disk has been demonstrable. With increasing experience this percentage has been somewhat decreased, but it is unquestionable that one occasionally encounters cases with a history that seems characteristic for herniated disk (Lasègue, disturbances of reflexes, sensibility and motility) where nevertheless the herniation is lacking. Surgery

only after a positive myelographic diagnosis would of course change this percentage entirely although on the other hand, as mentioned above, a number of herniations not demonstrable by myelography would thus not come to the beneficial surgical treatment.

To these non-herniation cases we have, however, also referred the cases of protrusio disci. In these one at operation finds that the disk bulges diffusely backwards, hereby causing a mechanical pressure on the root. In many cases the protrusion is marked and reaches the height of one-half centimeter. Commonly the nerve lies closely adherent to such a threshold-forming protrusion and is difficult to disengage. In other cases the root canal is constricted by the lowering of the disk. The author is on the other hand not convinced that a "hypertrophie ligamentum flavum" is of importance as a symptom-giving change. Largely speaking it may be said that such anatomical changes as may be considered to cause a compression of the nerve, are established in 50 to 60 per cent of the cases. In the individual case it is often difficult to decide whether the anatomy rightly should be termed pathological or physiological. We therefore prefer to keep this group distinctly apart from the cases of true herniation of the disk.

If these cases are referred to the herniated disk group, as often is done in statistical surveys on disk herniation, the aforementioned figure of negative explorations is reduced by one-half, and it might in that event be stated that we in 8 per cent of the surgically treated cases have not found any anatomical explanation to the sciatic syndrome.

The operation in these cases takes the form of a decompression, which in the event of instability here also is accompanied by a modified Albee-operation. The question of resection of the root is in these cases where the nerve, by way of example, rides over a firm threshold, more often actualized than in cases of herniated disk. Before performing a root resection one should be definitely certain that the root is affected. In recent years the author has therefore resorted to root resection nearly exclusively in cases of spondylolisthesis, where the root is firmly compressed over the margin and the patient has had severe neuralgic pain from the leg. Cases of spondylolisthesis, however, are not included in this survey.

In a number of cases there is no demonstrable anatomical change, as mentioned above. An analysis of these cases shows

that there occasionally is question of neuroses, which perhaps by the examiner have been suggested up to a syndrome of herniated disk, but often one is complete doubt as to the pathogenesis.

A number of curiosities also turn up; the author has thus had a case of intradural atheroma, a case of multiple neurinoma with tumors intradurally on L IV, and also on the sciatic trunk of the thigh. Both of these cases were first explored on the suspicion of herniated disk, but without positive findings. As the symptoms continued myelography was done, whereby intradural tumor was established.

The surgical results in these cases of suspected intervertebral disk appear from table 5.

Table 5.

Follow-up examination of 79 cases operated upon on the suspicion of herniated intervertebral disk, in which this was not present, 1½ to 6 years postoperatively.

	"Protrusio disci" (42 cases)	Other cases (37 cases)
<i>Symptoms from the legs</i>		
None, or but slight symptoms	35	29
More persistant symptoms	5	8
Later re-operated for herniated disk	2	—
<i>Back symptoms</i>		
None, or but slight symptoms	37	27
Pronounced symptoms	5	10

Thus, the follow-up examination shows that the majority of the patients with suspected herniation of the disk have been improved by the surgical intervention — decompression and a modified Albee-procedure or root-resection. In 2 of the protrusio-disci cases a herniation of the disk has subsequently occurred and has been surgically removed.

Indications for Operation.

The indications for surgical treatment of a case of sciatica, in which the clinical diagnosis of herniation of the disk has been made, must be highly individualized. Naturally the operative treatment should be preceded by a period of conservative therapy. The object of the operation is to relieve the patient from the subjective discomforts, from his aches and pains, and the more severe and prolonged and therapy resistant these are, the stronger

the indication for surgery. If a paresis of more pronounced nature than a slight decrease of the great toe power has occurred there is a further indication for the operation. The prospects for a restitution are greater if the nerve root is relieved from the pressure. There is no definite rule as to the length of time that should elapse between the onset of the sciatic symptoms and to the operation. It is only in exceptional cases that surgery is necessitated before several months have passed. There is on the other hand no reason to prolong the conservative treatment with bed rest and braces indefinitely. If these measures do not afford a speedy result the patient still has the prospect of operatively being relieved from his pain and soon becoming fit for work. This latter factor, the restitution of the patients' working capacity, is of great socio-economic importance.

On discussing the possibilities of an operation for herniated disk with the patient one may venture to say:

1. that he has a 80 to 90 per cent chance of being virtually cured by the operation.

2. that slight paresthesias as well as moderate back pain which do not interfere with the working capacity periodically occur in one third of the cases.

3. that there is a chance of 1 on 15 or 20 that he will have a recidivation but that this with about the same success can be removed.

4. that there furthermore is a risk of about 5 per cent that he for the future will have sensations in the leg of a recidivating nature, although not more pronounced than that they with rest and so forth will disappear.

5. that there is a slight risk that he will have symptoms from the other leg, and that he, as well as every one else, may have a herniation at some other site.

6. that if the back pains have been prolonged and severe he must expect such pains also in the future. The operation for herniated disk will mainly relieve the leg symptoms.

7. that even if no true herniation is demonstrated at operation, some other type of compression of the nervroot often exists, and that he still has a good chance of being improved by the operation.

8. that he does not have to apprehend getting worse from the intervention.

Most patients, tormented by sciatic pain, are eager to take this chance.

Summary.

The author first discusses the diagnosis of herniation, on the basis of 500 surgically verified cases of disk herniation. In approximately 60 per cent the herniation has originated from the lowest, the lumbosacral disk, in 40 per cent from the disk between L IV—L V while disk herniations from the other lumbar disks are rare. Multiple disk herniations causing symptoms are very uncommon. With the neurological root diagnosis only there was in 75 per cent of the cases success in exact localization of the involved disk; in 25 per cent of the cases more than 1 interstice had to be explored at operation. Myelography with positive contrast media should in the opinion of the author not be used as a routine method, for one reason because of the irritating effect of the contrast media available at present — 3 cases complicated with epileptiform attacks due to this are reported — another reason being that a “normal” myelography does not exclude disk herniation. The necessity of a gentle operative technic and a meticulous hemostasis is stressed. If instability is established at operation a modified Albee operation is recommended. The immediate postoperative results are generally characterized by the instantaneous disappearance of the symptoms and 71 per cent of the patients are discharged after 2 weeks of hospitalization, another 17 per cent within 3 weeks postoperatively. Complications, marked back pain, cramps and recidivations are reported. The late results of 375 cases followed from 1½ to 6 years after operation are surveyed (96 per cent of the cases were re-examined), and are grouped in tabulations. Not infrequently there is at operation not established a disk herniation, although the patient has revealed symptoms characteristic for “disk herniation”. This has occurred in 16 per cent of the present series. Out of these more than one-half have shown anatomical changes in the form of protrusion of the disk owing to a root compression. In the rest of the cases, approximately 8 per cent, no palpable explanation to the sciatic symptoms has been found. The result of these interventions is presented in tabular form, the indications for operation are discussed, and the prospects of improvement of the sciatic patient following operation are summarized in 8 points.

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Internal Closure of Monaldi Fistula During Thoracoplasty with Extrapleural Apicolysis.

By

JOHAN HOLST.

Preliminary Report.

Monaldi treatment alone very seldom results in permanent closure of tuberculous cavities. But it is generally agreed that in some cases drainage and suction of the cavity has such local and general effects, that originally bad operative risks are transformed into relatively good ones.

The place of the Monaldi treatment should therefore be as a preliminary preparation for final operative treatment in exceptional cases. Preliminary drainage without suction of large cavities with ample expectoration has been suggested and used by GUNNAR NYSTRÖM, and others (also in a few cases in our clinic), before Monaldi published his method. The disadvantage of Monaldi's method, and any other kind of preoperative drainage of tuberculous cavities, is the remaining fistula. In some cases the fistula will close if the residual cavity is collapsed by a thoracoplasty. In others it will remain. The fistula also interferes with the operation. The usual procedure in cases with Monaldi fistulas is to perform thoracoplasty without apicolysis from a posterior incision, avoiding the fistula. In this way the collapse will be missed where it is most needed, namely anteriorly, where the lung is adherent to the thoracic wall round the fistula. Attempts to resect the costal cartilages from an additional anterior incision, entail the risk of opening the fistula, with subsequent tuberculosis of the wound cavity and the thoracic wall.

In the past two years (since 1946) I have used, in cases with Monaldi fistulas, a technique which closes the fistula *in the lung*, and thus makes it possible to separate the lung from the thoracic wall and perform a thoracoplasty with extrapleural apicolysis.

The operation is carried out in the following way:

The Monaldi tube is left in situ.

The first three ribs are removed in total. The extrapleural layer is found posteriorly or over the apex. The apex is freed and the lung is stripped extrapleurally from the mediastinum and the spine. The periosteum and intercostal bundles of the three upper ribs are cut posteriorly as near the spine as possible. The lung is freed anteriorly — in the extrapleural layer — until the fistula is reached. The wall of the fistula is incised, the Monaldi tube withdrawn and removed, and the lung cut away from the anterior thoracic wall, where it is adherent round the fistula. A piece of gauze is pressed against the open fistula at the lung surface to avoid soiling, and the extrapleural strip is continued downwards under the periosteum of the anterior part of the three resected ribs. Finally the periosteum of these three ribs with their intercostal bundles are divided. If possible the extrapleural strips should be so extensive that soft pulmonary tissue and pleura can be folded over the fistula and the surrounding infiltration.

The schematic figures 1 and 2 illustrate the situation before and after the mobilisation of the lung.

Suture of the fistula in the lung. If possible we try to fold the adjoining visceral pleura over the fistula as shown in figs. 3, 4. This can only be done in cases where the pleura is not too stiff, and the infiltration surrounding the fistula not too extensive. It has been possible in five of the six cases where we have done this operation. In the one case where it was not possible to fold the pleura over the fistula, the opening was closed with two mattress sutures.

The most important step is the *covering of the suture with periosteum and intercostal muscles.*

The method used is shown schematically in figs. 5, 6, 7: The suture line is covered with the periosteum of the two adjacent ribs, one over the other (fig. 6, 7).

In order to do this properly, a careful dissection of sufficiently long anterior ends of the periosteum and intercostal bundles is required, which is best done extrapleurally. In our regular thoracoplasties with extrapleural apicolysis we apply, as a routine, a

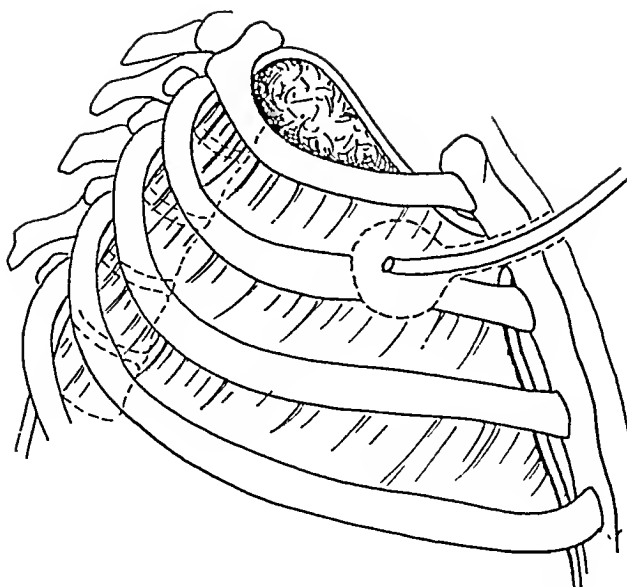


Fig. 1. Schematic drawing of Monaldi's drainage.

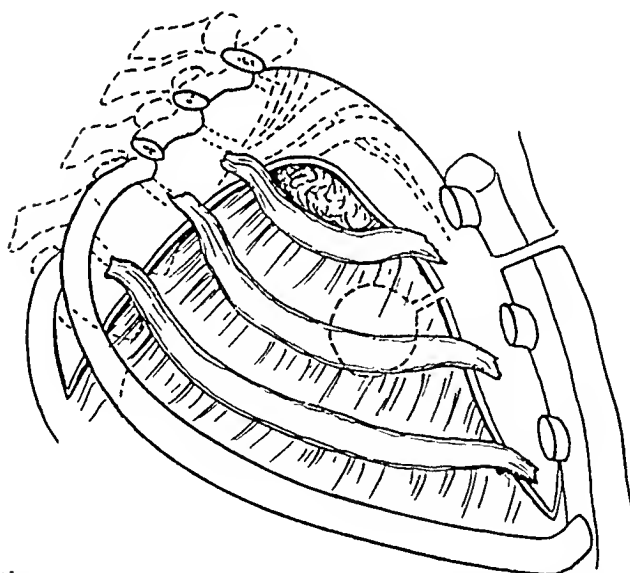


Fig. 2. The three upper ribs are removed. An extrapleural strip is done over the apex on the mediastinal side and posteriorly, and anteriorly over the upper lobe. The periosteum and intercostal bundles are cut anteriorly and posteriorly. The fistula with surrounding adhesions to the thoracic wall is severed.

HOLST: Internal Closure of Monaldi Fistula.

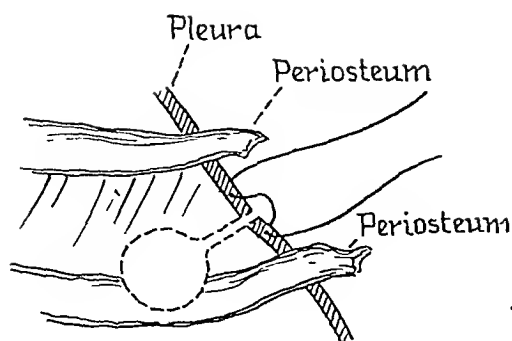


Fig. 3. The first catgut suture inserted in the pleura on both sides of the fistula.

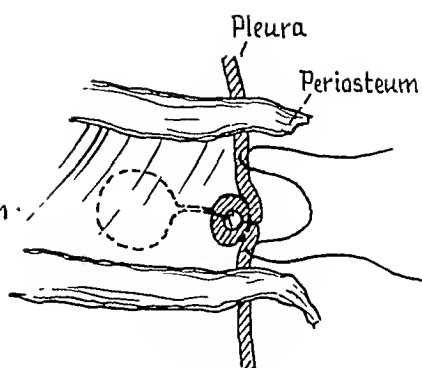


Fig. 4. The first suture tied, and the second pleural suture inserted.

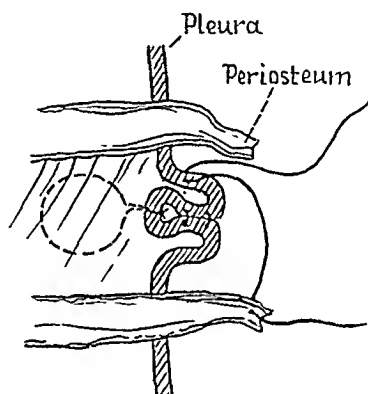


Fig. 5. Both pleural sutures tied. Suture for the first covering periosteum inserted.

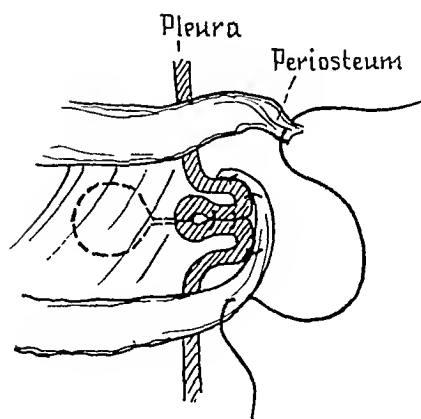


Fig. 6. Suture inserted for the second covering periosteum.

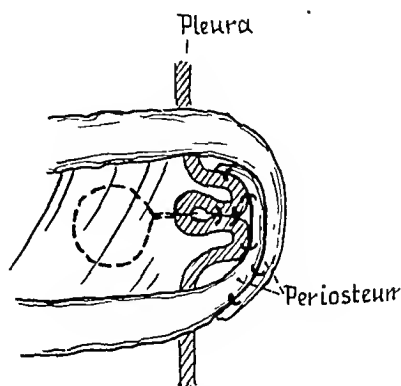
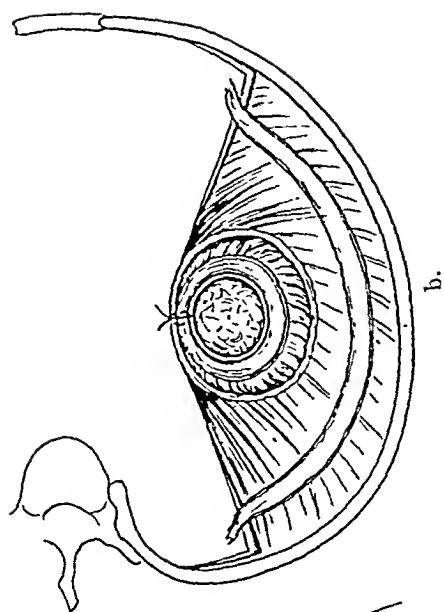
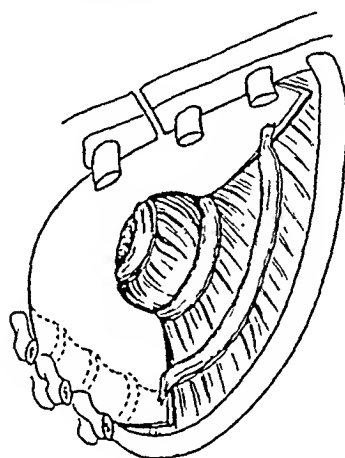


Fig. 7. Closure of the fistula completed.



b.

Fig. 9 a, b. Purse-string suture tied.



a.

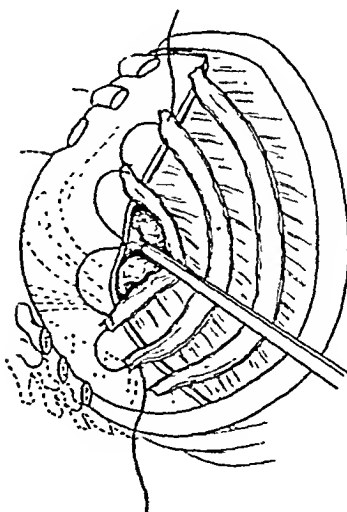


Fig. 8. Purse-string suture inserted for folding in the apex and placing the periosteum in correct position.



Fig. 10. Large cavity before treatment.



Fig. 11. The same cavity as seen in Fig. 10 after Monaldi's drainage.



Fig. 12. The same patient one year after upper lobe thoracoplasty with extrapleural apicolysis and internal closure of the Monaldi fistula.

The patient is free from clinical symptoms. No sputum. Cultures of gastric content negative.

purse-string suture to fold in the apex of the lung to prevent it from reexpansion and to keep the periosteum in the position required for the regenerating ribs to form a correct new thoracic dome.

The suture runs through the anterior ends of the periosteum of the two or three upper ribs, through the pleura on the medial surface of the apex and thence through the posterior ends of the same periosteum (fig. 8). This suture is originally suggested by REFSUM in 1938, and later modified to some extent. In two of our cases it was possible to combine the covering of the fistula with a suture of this kind.

If proper anterior ends of the periosteum are provided, a very solid covering of the fistula can be made.

The fistula in the thoracic wall has been closed with a few catgut sutures from the inside of the wound cavity in some cases, left alone in others. It does not seem to matter whatever procedure is used. In all cases the fistula in the thoracic wall has healed in a surprisingly short time. No attempt has been made to excise the fistula.

The technique described has been employed in seven cases since 1946. All cases have received large doses of penicillin pre- and postoperatively in the wound cavity and systemic.

In the first two cases streptomycin was *not* applied, while the subsequent four cases have also had pre- and postoperative streptomycin treatment.

In six cases the wound healing has been primary and uneventful.

In a seventh case the Monaldi tube had been removed some time before admission. At operation a tuberculous abscess was found inside the thoracic wall. The fistula in the lung was closed, and there has been no sign of its reopening, but a fistula from the wound cavity still remains.¹

Abscesses of this kind may occur even when the Monaldi tube is left in situ, but are more liable to do so after removal of the tube. This is one reason why the tube should be left in position until the thoracoplasty is performed. Another reason is that the remaining tube facilitates the exact localisation of the fistula during the operation.

In all our cases, except one, we have been surprised to find a moderate infiltration, in spite of the giant cavities present before Monaldi treatment. If confirmed in a greater number of

¹ Addendum: The fistula is later closed, and the patient free from symptoms.
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observations, this might suggest a regression of the pericavernous infiltration caused by drainage and suction. This does not seem unlikely, considering what we know in general of the influence of drainage on the reactive processes surrounding an abscess cavity.

If this proves correct, it indicates a long period of preoperative Monaldi treatment. There may also be other reasons for this, especially the general condition of the patient. The case in which an intrathoracic abscess originating from the fistula was found, and delayed the wound-healing illustrates the main danger involved in the procedure described. Experience, skill and care in the application of the Monaldi tube will reduce this danger.

With a technique similar to the one described, we have also successfully treated some cases of pulmonary lesions and rupture of cavities during apicolysis, especially in revision thoracoplasty.

It is probable that the use of streptomycin in our later cases has been a valuable supplement to the surgical treatment. The same applies to penicillin protecting against non-specific infections. The fact that the first cases healed without application of streptomycin demonstrates that surgery is the decisive factor: We cannot count on preventing tuberculosis in the wound cavity by application of streptomycin if the suture is insufficient.

It remains to be decided after *longer* observation of *more* cases, whether the technique described is justified as a method of choice in patients with pulmonary tuberculosis needing preoperative Monaldi drainage, or whether it should be reserved for exceptional cases.

Summary.

A technique is described for suture of Monaldi fistulas in the lung in combination with thoracoplasty with extrapleural apicolysis, and for repair of cavities accidentally ruptured during operation.

With this method six uncomplicated Monaldi fistulas were closed, and primary healing of the wound followed. In one case with an intrathoracic tuberculous abscess, a fistula occurred temporary, but healed after some time.

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Some Aspects of the Mutual Relations Between the Diseases of the Liver and Those of the Biliary Ducts.

By

ERNST BERGENFELDT,
M. D.

It has long since been the practice to divide diseases of the liver and biliary ducts into two entirely separate categories, namely, parenchymal diseases of the liver on the one hand and diseases of the outflowing biliary ducts on the other. The diseases embraced in the former category, of which, in the matter now before us, hepatitis is of primary interest, fall predominantly within the scope of the physician whilst those belonging to the latter category fall within the scope of the surgeon. This strict division of diseases of the liver and biliary ducts into medical and surgical categories has, amongst other things, resulted in the fact that hepatitis was, for a long time, considered to be a *Noli me tangere* for the surgeon. The process of the disease was considered as being as good as entirely localized to the hepatic parenchyma, beyond the reach of surgical therapy: as a matter of fact a surgical operation was regarded as being not only objectless but even directly injurious because of the extra strain which such intervention is supposed to put on the liver.

Such a classification of parenchymal diseases on the one hand and diseases of the biliary ducts on the other can be justified from practical therapeutical points of view, but it cannot be anything other than grossly schematic and, in many cases, is decidedly misleading. The liver and the biliary ducts may be re-

garded anatomically and physiologically, as being one sole unitary organ. The most intimate anatomic relationship exists between the parenchyma and the biliary ducts since, as we know, the biliary ducts, in their finest terminal ramifications, only form gaps between the epithelial cells of the liver without their own biliary duct covering. A priori it is therefore probable that disease processes in one or other of these tissual regions — the hepatic parenchyma and/or the biliary ducts — would also bring about changes within the other. This applies especially to inflammatory processes.

It has long since been known that obstruction in the biliary ducts gradually causes injuries to the liver which, in prolonged cases, can terminate in biliary cirrhosis. Likewise the connection between cholangitis and acute, purulent liver processes is well known. By means of histological examinations of biopsy specimens of the liver, ÅGERUP has been able to show that hepatic changes occur in practically all cases of acute cholecystitis, in the majority of cases of chronic cholecystitis as well as in individual cases of cholelithiasis (1944). Similar results were also previously obtained by the American, GRAHAM (1918), and the Italian, PETTINARI (1932), during the course of their investigations (from ÅGERUP). This is confirmed clinically by the fact that gall stone diseases often proceed with icterus even without the presence of concrement in the choledochus. In previous works the writer considered that he was able to show that, conversely, acute hepatitis can bring about changes in the biliary ducts in the form of a gathering of mucus and possibly, other exudative products, the presence of which can make the evacuation of the bile into the intestine difficult and thereby delay or prevent the cure of the hepatitis. The writer has obtained support for this opinion from the effect of operative treatment of acute hepatitis consisting of perfusion of the biliary ducts, through post-mortem examinations as well as from the fact that in many cases acute hepatitis presents an increase in the serum phosphatase value (BUCH 50 %, ODIN 66 %, BERGENFELDT 78 %).

The modern tests for liver function for differential diagnosis between parenchymal icterus and obstructive jaundice which, on the basis of THUNBERG-SJÖSTRÖM's test for citric acid in the serum and ROBERT's serum phosphatase test, were introduced by LEHMANN and BUCH, gave great hopes in the beginning. Thus in 1941 LEHMANN produced statistics for 450 cases in which the

laboratory diagnosis seemed to be correct in 90 %. Later statistics, however, have given much poorer results. In a purely surgical material (where the clinical diagnosis was verified during the operation and was therefore probably more certain than in Lehmann's material which was for the main part a medical one) WESTERBORN (1945) had a correct laboratory diagnosis in 66 % of the 56 cases of obstruction in the biliary ducts. (If one only includes the laboratory diagnosis "mechanical obstruction" and excludes "cystic obstruction" the figure falls to 48 %.) Of 31 cases of hepatitis or cirrhosis the laboratory diagnosis was correct in 71 %.

The reason why laboratory diagnosis is not seldom wrong is probably due partly to the fact that it is often not a question of *either* a parenchymal disease *or* a disease of the biliary ducts but rather a matter of being *both . . . and*. This is especially the case if the disease is of long standing. The writer shall now give some concrete cases which will show how interwoven with each other parenchymal changes and changes in the biliary ducts can be.

Case I. Wife of a doctor, aged 42 years. Previously experienced pains of the gall stone type, but not, however, during the past two years. At the beginning of October 1947 she fell ill with icterus accompanied by dull pains in the region of the liver. She was admitted to the surgical department of the Västerås Hospital on 7/10. As the differential diagnosis between hepatitis and choledochus stone was not clear, a blood specimen was sent to Lehmann's laboratory in Gothenburg on 15/10 (2 weeks after she fell ill). The laboratory analysis showed definite hepatic values: *citric acid in the serum* was 39, *serum phosphatase* 9, *thymol-test* 0.10, *Meulengracht* 60. A week later another specimen was sent and even on this occasion the analysis showed undoubted hepatitis values: *serum phosphatase* 8, *Meulengracht* 30, *thymol-test* 0.13. As the jaundice gradually began to recede and the subjective troubles to disappear, the patient was discharged at her own request on 30/10. At that time the *Meulengracht* was 15. After discharge, however, she felt that she was not well: she was tired and languid and, periodically, was troubled with a diffuse discomfort in the region of the liver. The jaundice never disappeared entirely but was sometimes more pronounced and sometimes less so. She was re-admitted 11/5 1948. The laboratory tests made on 14/5 gave the following values: *citric acid in the serum* 38, *serum phosphatase* 29, *Meulengracht* 13, *thymol-test* 0.12 which, in the opinion of the laboratory was to be regarded as being *cirrhosis values*. Nevertheless an *operation* was performed on 19/5 at which ten facct-shaped stones as big as hazel-nuts were removed from the choledochus-hepaticus. The gall bladder also contained stones and was the seat of a chronic inflammation. The patient was discharged completely cured on 9/6. Her icterus has not since recurred. Re-examination on 26/7

showed from the laboratory analysis that the serum phosphatase, Meulengracht and thymol-test values were normal.

The remarkable thing about this case is that from the repeated tests which were made during the first time she was in hospital no increase in phosphatase could be shown despite the presence of numerous stones in the choledochus. Investigations which were carried out on dogs by M. WACHSTEIN and F. G. ZAK (1946) show that ligation of the ductus choledochus is constantly followed by a powerful increase of alkaline phosphatase in the blood. A number of clinical observations point to the fact that even in man an obstruction for the flow of bile through the choledochus gives rise to an increase in phosphatase. One is therefore forced into the belief that in this case, at least in the beginning, it was not a question of obstructive jaundice but rather one of a hepatitis which was prevented from healing because of the choledochus stones. This would seem to be even more palpable in the next case.

Case II. Married woman, aged 38 years. Was treated in another hospital from $\frac{9}{1}$ to $\frac{20}{1}$ 1948 diagnosed as a case of Hepatitis epidemica. Prior to this she was at home for 7 weeks suffering from icterus of a high degree. The laboratory analysis (Göteborg) on $\frac{14}{1}$ was: serum phosphatase 6, Meulengracht 45, thymol-test 0.13. On $\frac{30}{1}$ it was: serum phosphatase 6, Meulengracht 18, thymol-test 0.15. Thus the analysis on both occasions showed pronounced hepatic values. On being discharged from hospital she was at first better but later on she grew worse again. She was therefore admitted to the Medical Department of the Västerås Hospital where, for three different periods between $\frac{23}{2}$ and $\frac{4}{6}$, she was treated as a diagnosed case of hepatitis acuta. The laboratory analysis of $\frac{2}{4}$ still showed hepatic values as follows: citric acid in the serum 49, serum phosphatase 10, Meulengracht 22, thymol-test 0.10. On being transferred to the Surgical Department she underwent an operation on $\frac{16}{6}$ when 10 faced-shaped stones the size of a large pea were removed from the hepaticus-choledochus whilst from the lower part of the choledochus a globular stone the size of a large hazel-nut was also removed. There were also stones in the gall bladder which was in a state of chronic inflammation and was therefore removed. She was discharged as cured 2 weeks after the operation. The serum phosphatase, Meulengracht and thymol-test values were normal.

In this case the similar, fully uniform blood analyses made at different periods during the illness speak decidedly in favour of a diagnosis of hepatitis. The lengthy course of the illness — almost 7 months — has its explanation in the fact that there was concrement in the choledochus.

rapidly after the operation. On $\frac{2}{8}$ Meulengracht was 8. The patient was discharged as cured on $\frac{9}{8}$. The patient was re-examined on $\frac{11}{11}$ 1948. She feels well, there is no icterus and no enlargement of the liver. Meulengracht was 8.

This then was a microscopically verified case of hepatitis which had probably lasted for one year and which receded rapidly after operative treatment when the biliary ducts were cleansed by removing the inflammatorily changed gall bladder and by perfusing the biliary passages.

The cases reported here, show how interwoven parenchymal changes in the liver and changes in the biliary ducts can be. Some of them also illustrate how difficult it is to arrive at a sure differential diagnosis between hepatitis and obstructive jaundice, despite all the modern methods. In those cases, which are far from being uncommon, where the laboratory analysis is faulty, the cause is probably often a similar combination of diseases of the liver and the biliary ducts. The practical consequences of this is, that, to a certain extent, we are still obliged to resort to exploratory laparotomy. In this respect a suspicion of hepatitis ought not to constitute contra-indications for operating. As the writer has shown in his previous works, a prolonged, acute hepatitis which will not recede by internal therapy can be successfully treated surgically by perfusing the biliary ducts. In this connection the writer would point out there is no need to resort to choledochotomy — as a rule this should not be resorted to — as the operation is unnecessarily a great one. Perfusion is performed with equally good effect directly through the gall bladder. After a cannula has been introduced and fastened by means of a tobacco-bag suture, the contents of the gall bladder are aspirated after which it is filled with contrast medium. An abdominal cloth is then placed over the gall bladder, the contrast medium is pressed out into the biliary passages by means of applying manual pressure evenly over the whole of the gall bladder. Cholangiograms are taken during compression after which the contrast medium remaining in the gall bladder is aspirated. The gall bladder is now filled with 30 to 40 ml physiologic salt solution which, in its turn, is pressed out and this latter procedure is repeated once or twice. The whole procedure is one that is easily performed as well as being a protective measure.

If one takes this more active attitude regarding the treatment of hepatitis it is quite probable that, behind the diagnosis hepa-

titis, one will discover, in certain cases, changes in the biliary ducts or in the gall bladder which can be reached by surgical therapy. This, perhaps, applies more particularly to cases of recurring hepatitis. In such cases the morbid changes (concrement, inflammatorily changed gall bladder) should be removed and the biliary passages cleansed in order to create the most favourable conditions possible for the hepatitis to heal up.

Summary.

In the author's opinion the reason why the modern liver function tests for differential diagnosis between parenchymal and obstructive icterus is not seldom wrong is because it is often not a question of *either* an injury to the parenchyma *or* a disease of the biliary ducts but rather one of it being *both . . . and*. It has long since been known that obstruction in the biliary ducts can gradually lead to parenchymal injury of the liver with subsequent biliary cirrhosis. The same applies to the connection between cholangitis and acute purulent processes in the liver. ÅGERUP and others have shown that cholecystitis is almost invariably accompanied by hepatic changes. In previous works, the writer has considered that he has been able to show that, conversely, hepatitis brings about changes in the biliary passages. Some cases are reported which illustrate how interwoven with each other diseases of the liver and biliary ducts can be and further they depict the uncertainty of differential diagnosis despite all the modern resources. As yet one cannot avoid exploratory laparotomy in certain cases. A suspicion of hepatitis should not act as a deterrent because acute hepatitis can be successfully treated surgically by perfusing the biliary passages. For this reason one should not resort to so great an operation as choledochotomy: perfusion can be performed with equally good effect via the gall bladder. If one takes this more active attitude regarding the treatment of hepatitis it is quite probable that in certain cases one will discover behind the diagnosis hepatitis changes in the biliary ducts or in the gall bladder which can be reached by surgical therapy. These morbid changes (concrement, inflammatorily changed gall bladder) should be removed and the biliary passages cleansed in order to create the most favourable conditions possible for the healing up of the hepatitis.

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An Analysis of a Surgical Biliary Tract Material.

By

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The object of the present investigation is to ascertain, by means of an analysis of a biliary tract material from a Swedish hospital during a period of 15 years (1933—1947), whether a decreased mortality in various groups of diseases is to be found during the last five-year period. Fluid balance control and improved methods of anesthesia, among other things, have been practised in recent years, which may be supposed to have had an influence on the mortality. The possibility of lowering the post-operative primary mortality is discussed in the light of the results arrived at. Special attention will in this connection be paid to pre- and post-operative treatment of the patients, especially in cases with extrahepatic biliary obstruction.

The material consists of 917 biliary tract cases, operated upon in the years 1933—1947. They are divided into two groups: malign and non-malign cases. The main part is constituted by the non-malign cases (899 cases), the malign cases constituting a smaller group (18 cases). The *non-malign* cases are divided into two main groups: cases without obstruction in the common bile duct and cases with such obstruction. Both these groups include cases of acute and chronic cholecystitis, and in the latter group three cases of traumatic stricture of the common duct are found and one case of cirrhosis of the pancreas, besides obstruction in the form of stone. Only cases presenting a gangrenous gallbladder were counted as acute cholecystitis. These cases were operated upon immediately after the arrival at the hospital or a few days

afterwards. The operations were performed for various reasons: risk of perforation of a dilated gallbladder causing severe pain, diffuse peritonitis the origin of which was obscure before the operation, or cases not receding with conservative therapy. Cases of subacute cholecystitis were counted as chronic cholecystitis. These cases showed earlier signs of cholecystitis and arrived in a state of acute relapse, receding after a few days and subsequently operated upon, generally after two weeks. As chronic were counted all cases of chronic cholecystitis, *i. e.* simple catarrhal cholecystitis localized solely to the mucosa (also cholesterosis) and chronic cholecystitis comprising the entire wall of the gallbladder. The chronic cases without obstruction were mostly in a good condition before the operation and afebrile. It should be mentioned that the operation indications were similar in all cases during the three five-year periods. During the last five-year period, however, the inclination to resort to operation in cases of chronic cholecystitis was stronger than earlier. The main part of the *malign cases* consisted of carcinoma in the head of the pancreas.

A. Non-malign Cases.

1. *Total Mortality During Three Five-year Periods and Distribution of Age.*

In all, 899 cases were operated upon, out of which death ensued in 77 cases: mortality 8 %. The main part of the cases, or 752 (84 %), were female. The number of male cases operated upon is low and about the same in the three periods (approximately $\frac{1}{6}$ of the number of female cases). The total number of cases is about the same in the first two five-year periods, but is almost doubled during the years 1943—1947. As may be seen from table 3, this increase is due to the increased number of operations in cases of chronic cholecystitis.

It is well known that diseases of the biliary tract are more common in women than in men. LICHTMAN (1942) states cholelithiasis to be 1.5—6 times more frequent in women than in men. He says that there is a great deal of truth in the expression »female, fat and forty» where chronic cholecystitis is concerned.

As the material from the three five-year periods is somewhat varying as to the distribution of age (see table 2b), and as furthermore the number of males, the mortality of whom is higher than

Table 1.

Total Number of Cases and Mortality During the Different Periods.

	Female	Dead	Male	Dead	Total number	Dead
1933.....	26	—	9	3	35	3
34.....	27	3	7	—	34	3
35.....	39	5	9	2	48	7
36.....	49	3	7	1	56	4
37.....	52	5	11	3	63	8
	193	16 (8%) ¹	43	9 (21%)	236	25 (10%)
1938.....	44	3	9	1	53	4
39.....	34	5	13	2	47	7
40.....	34	6	7	1	41	7
41.....	43	1	12	3	55	4
42.....	32	3	5	4	37	7
	187	18 (10%)	46	11 (24%)	233	29 (12%)
1943.....	45	3	9	3	54	6
44.....	60	—	12	2	72	2
45.....	79	4	13	—	92	4
46.....	91	5	13	1	104	6
47.....	97	4	11	1	108	5
	372	16 (4%)	58	7 (12%)	430	23 (5%)

¹ The figures within brackets in this and the following tables express the mortality in per cent.

that of the females (see table 1), is comparatively lower during the last five-year period, a special method ("the method of the calculated cases") was employed with the object of eliminating the influence of these differences upon the comparison of the mortality in the three periods.

The material was divided into eight groups (the male cases into four and the female cases into four groups of age). After that the "method of the calculated cases" was employed, *i. e.* in the case of each five-year period the number of deaths was calculated that would have occurred if the percentage of deaths in each of the eight groups had been in accordance with the material as a whole. With this way of dividing the cases into groups, the calculated number of deaths proved to be the following: 1933—37: 20.46; 1938—42: 21.57; 1943—47: 34.97. The difference between the calculated and the actual number of deaths in the last period is

$34.97 - 23 = 11.97 \pm 3.99$,¹ whence is derived $P = 0.0027$. The mortality is thus significantly lower during the last five-year period than during the first ten years. It should be kept in mind, however, that this lower mortality during the years 1943—47 is to some extent influenced by the greater inclination during this period towards operating, which has brought a greater number of light cases into the material.

Mortality (per cent).

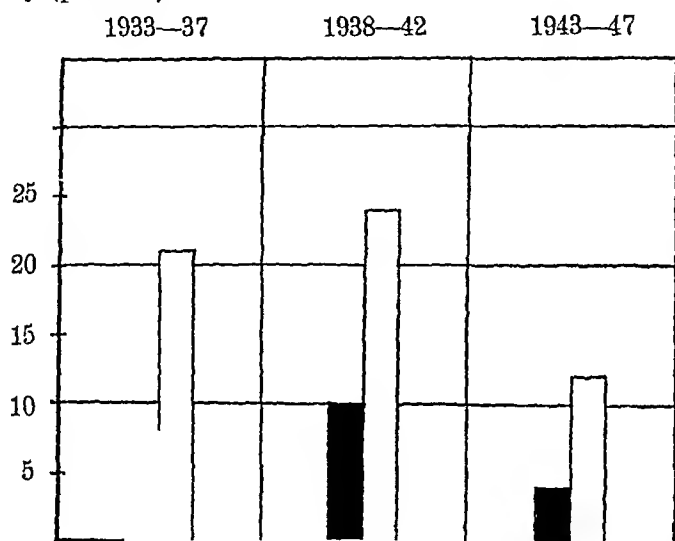


Fig. 1. The mortality of female (black column) and male patients (white column) during three five-year periods.

It has been pointed out earlier that the total mortality in operations of the biliary tract has decreased in recent years.

WALTERS and SNELL (1940) thus state that it has decreased from 10 to 3 % during the last fifty years, and HELLSTRÖM (1942) found the mortality in a Swedish material to be 7.4 % during the years 1914—34 but only 3.4 % during the years 1940—42. SWEDBERG (1948) studied a Swedish biliary tract material from the years 1925—43 but did not find the total mortality to have decreased in the years 1940—45, in spite of the introduction of fluid balance control and improved methods of anesthesia.

The high mortality of the male patients throughout the three five-year periods observed in our material is remarkable. Even though a decrease is to be observed during the last five-year

¹ As to the calculation of the mean error, see WAHLUND, S., *Demographic Studies in the Nomadic and the Settled Population of Northern Lapland*, Uppsala 1932 (p. 48, formula 3b and note 1).

Table 2.

Distribution of Age.

a. During the years 1933—47.

Age	Number	Dead	Mortality (per cent).
0—20.....	4	—	—
21—40.....	267	6	2
41—60.....	477	35	7
61—.....	151	36	24

b. During the three five-year periods.

Age	1933—37			1938—42			1943—47		
	female	male	dead	female	male	dead	female	male	dead
0—20...	1	—	—	2	—	—	1	—	—
21—40...	51	7	2 (4%)	56	10	2 (3%)	132	11	2 (1%)
41—60...	122	23	14 (10%)	95	23	11 (9%)	182	32	10 (5%)
61—.....	18	13	9 (20%)	34	13	16 (34%)	57	15	11 (14%)

c. Deceased males and females during the years 1933—47.

Age	Female		Male	
	number	dead	number	dead
0—20.....	4	—	—	—
21—40.....	239	5 (2%)	28	1 (4%)
41—60.....	399	27 (7%)	78	8 (10%)
61—.....	110	20 (18%)	41	16 (39%)

period, the mortality is more than double that of the female patients. This may partly be explained by a higher percentage of males than of females presenting acute cholecystitis (18 and 9 % respectively). As is shown by table 3, the mortality is considerably higher in acute cholecystitis than *e. g.* in cases of chronic cholecystitis. Table 2c shows that the mortality of the male patients is not higher throughout than that of the female patients in the four different age groups. Only in the highest age group a clear discrepancy of mortality between the sexes is to be observed.

The mortality of the males is higher than that of the females in a material of 404 cases from a three-year period published by BOYCE, VEAL and McFETRIDGE (1936). Out of these cases, 235 were female and 109 male, the mortality of the former being 8.1 % and of the latter 11.9 %. SWEDBERG (1948) found a male mortality of 19 % and a female mortality of 9 %.

The largest number of cases belongs to the age group of 41—60 years with a total mortality of 7 %, then comes the group of 21—40 years, and after that the cases above 60 years, presenting the highest mortality (24 %). Only 4 cases were operated upon before the age of 20, and none of them died. BOYCE et al. (1936) in their material found more than 70 % of the deceased to be above 50 years of age, the highest mortality being presented by patients above the age of 70. A certain discrepancy in the distribution of age is to be observed during the three five-year periods, and among other things the percentage of females belonging to the group of 21—40 years of age is found to have increased during the years 1943—47.

2. Mortality in the Different Groups of Diseases.

In cases *without obstruction* of the common bile duct, acute cholecystitis presents a high mortality throughout the three periods (23, 18 and 29 %). A comparison between these three mortality dates does not disclose a significant difference.¹ In 3 cases, all belonging to the last five-year period, the patients were in a very bad condition, arriving in an acute state with diffuse peritonitis originated from a gangrenous gallbladder. The operation consisted only of laparotomy + drainage. These patients died very soon after the operation and were also afflicted by another disease (cardiosclerosis, polyarthritis, diabetes mellitus). Not counting these three cases, the mortality of the years 1943—47 is 23 %. The total number of cases of acute cholecystitis is 94 and that of chronic cholecystitis 635 (13 and 87 % respectively). Stones in the gallbladder were found in 77 of the acute cases (82 %) and in 615 of the chronic cases (97 %). Acute or chronic cholecystitis without cholelithiasis is thus not very common.

In BAUMGARTNER'S (1929) material, including 4,575 examined gall-bladders, stones were found in 60 % of the cases diagnosed as chronic catarrhal cholecystitis and in 90 % of the cases of acute or subacute cholecystitis. FALLIS and Mc CLURE (1940) found gallstones in 90.9 % of the cases of acute cholecystitis (320 cases).

Mortality in chronic cholecystitis is considerably lower (4, 7 and 2 % respectively) than in the acute cases. The difference of

¹ All the following comparisons are made with the use of χ^2 with 1 degree of freedom calculated according to FISCHER, R. A., *Statistical Methods for Research Workers*, London & Edinb., 1941, p. 90—93.

Table 3.

Mortality and the Frequency of Jaundice in Cases Without and With Obstruction of the Common Bile Duct.

a. *Without obstruction.*

Disease	1933—37			1938—42			1943—47		
	num- ber	dead	icter- us	num- ber	dead	icter- us	num- ber	dead	icter- us
<i>Cholecyst. ac.</i> with stone. . . .	22			31			24		
		5 (23%)	3		7 (18%)	2		10 (29%)	3
without stone.	—			7			10		
<i>Cholecyst. chron.</i> with stone. . . .	160			141			314		
		7 (4%)	14		10 (7%)	13		6 (2%)	48
without stone.	4			8			8		

b. *With obstruction.*

<i>Cholecyst. ac. . .</i>	3	1	2	—	—	—	—	—	—
<i>Cholecyst. chron.</i>	47	12	46	45	12	39	71	6	53
<i>Stricture</i>	—	—	—	1	—	—	2	—	2
<i>Cirrhosis of the pancreas</i>	—	—	—	—	—	—	1	1	1
	50	13 (26%)	48	46	12 (26%)	39	74	7 (9%)	56

mortality between the years 1943—47 and the years 1933—42 is almost significant ($0.05 > P > 0.02$).

Jaundice was at hand in 8 cases of acute cholecystitis (9 %) and in 75 cases of chronic cholecystitis (13 %).

According to LICHTMAN (1942), in cases without choledocholithiasis jaundice may be caused by 1) pancreatitis, 2) spasm of the sphincter of Oddi, 3) a large gallstone in the ampulla of the gallbladder, pressing directly on the common bile duct, 4) edematous inflammation of the gallbladder and the cystic duct, involving the common bile duct. To this may be added that hepatitis in connection with cholecystitis may produce jaundice. According to HIMSWORTH (1948), jaundice in cases of hepatitis is caused by compression of the bile capillaries through swelling of the liver cells. Jaundice caused by obstruction of the large bile ducts and jaundice associated with inflammation of the liver thus seem to be essentially the same thing. Both these phenomena are caused by obstruction, but they differ in the nature and place of the obstruction.

There are in all 170 cases of *obstruction* of the common bile duct. In 166 of these cases, the obstruction consisted of gallstones. Out of 896 cases, obstruction in the form of gallstones was thus

observed in 19 %, which is on the whole in accordance with the data given by earlier authors. It should be mentioned that the appearance of stones in the common bile duct in a surgical material to a large extent depends upon the praxis of exploring the common duct in cases of cholelithiasis.

CLUTE (1930) showed the appearance of stones to increase from 8.4 to 17.9 % as the number of choledochotomies in cholecystectomic operations increased from 15 to 33.8 %. GOLDMAN and BELL (1941) performed incisions of the common bile duct in 19.8 % of all operations of the biliary tract, finding stones in the common duct in 10.2 % of cases. Out of 251 cases examined by means of cholangiography, SCHUBERTH (1947) found common duct stone in 60 cases (24 %).

Jaundice is at hand in 144 out of 166 cases of cholecystitis (87 %). The frequency of jaundice is somewhat lower in the last five-year period (75 %) than in the two earlier periods (96 and 94 % respectively). The cause of this may be the fact that the indications for choledochotomy have been wider in recent years, appearing also in cases not presenting jaundice at the time of operation. Jaundice is one of the most constant signs of cholechoolithiasis.

LAHEY (1937) states the jaundice frequency to be 61 %, and KLINGENSTEIN (1931) 94 %. SCHUBERTH (1947) considers the jaundice frequency of a material to be in a certain proportion to the actual frequency of cholechoolithiasis. According to LICHTMAN (1942), the absence of jaundice is due to the insignificant size of the stone or to its eccentric position in the common bile duct. Intermittent icterus is characteristic of cholechoolithiasis. This is explained by the stone causing intermittent total or partial biliary stasis. According to WALTERS and SNELL (1940), complete occlusion of the common bile duct in cholechoolithiasis is at hand only in 13 % of cases, in stricture in 30 % and in carcinoma (of the pancreas) in 85 % of cases. LICHTMAN (1942) states that total biliary stasis for more than a week is not characteristic of cholechoolithiasis. According to his experience, total biliary stasis in cases of stone is produced when repeated attacks of biliary colic impact a row of non-faceted stones in the common bile duct and when a fairly solitary oval cholesterol stone completely engages the ampulla of Vater.

Out of the 170 cases, only 3 presented acute cholecystitis, the majority (163) being cases of chronic cholecystitis. Three cases presented obstruction in the form of traumatic stricture, and one case cirrhosis of the pancreas. 32 out of the 170 patients died, *i. e.* the mortality was 19 %. If the cases of chronic cholecystitis are extracted (163 cases), a mortality of 18 % is obtained. By way of comparison it may be mentioned that the total mortality of the

cases of chronic cholecystitis alone (1933—47) was 4 %. The mortality of the entire group of cases of biliary obstruction is high during the first two five-year periods (26 % during the both periods), whereas it is only 9 % during the years 1943—47. This decrease of mortality, however, compared with the mortality of

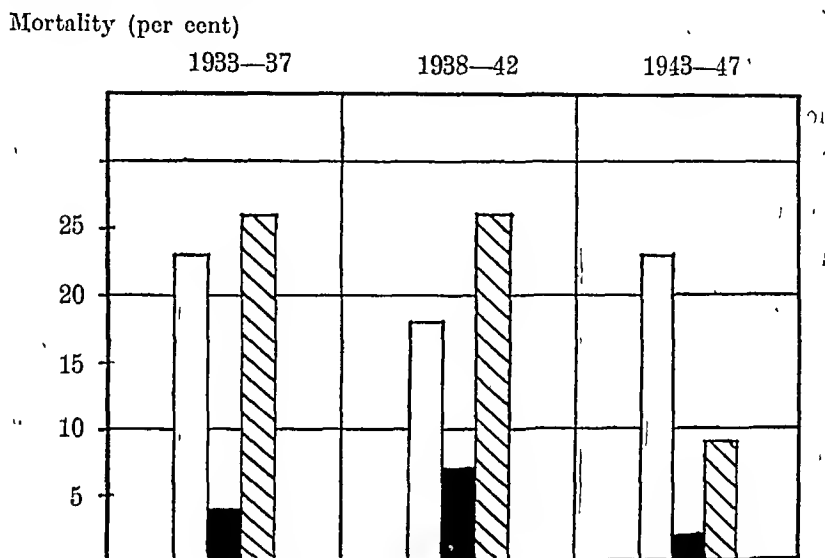


Fig. 2. Mortality in the different groups of diseases during three five-year periods. Acute cholecystitis (white column), chronic cholecystitis (black column) and obstruction of the common bile duct (dotted column).

the years 1933—42, is only almost significant ($0.02 > P > 0.01$). In comparing the mortality of cases of chronic cholecystitis without and with obstruction during the last five-year period (2 and 8 % respectively), an almost significant difference is had ($0.02 > P > 0.01$).

ULIN (1943), examining the mortality dates given by different authors in cases of obstruction of the common bile duct during the years 1920—39, has shown that no mortality decrease is to be observed in recent years. He considers the vitamin K therapy to have decreased the bleeding tendency in operations, but not the mortality. The following mortality dates obtained from Swedish materials are given: EHNMARK (1939) 13.7 %, HELLSTRÖM (1942) 13 % in cases of choledochotomy and 48 % in cases of choledochotomy with drainage of the hepatic duct, NORRBY (1943) 12.5 %. HELLSTRÖM (1942) and SWEDBERG (1948) point out that also in recent years choledochotomy has given high mortality in comparison with simple cholecystectomy. BACHHUBER (1946), examining an American material of 348 death cases in surgical diseases of the biliary tract during a ten-year period; found 33.4 %, *i. e.* $\frac{1}{3}$ of the cases, to be caused by choledocholithiasis.

In our material, 32 out of the 77 patients that died during the years 1933—47, *i. e.* almost half the cases, presented biliary obstruction. During the last five-year period 6 out of 23 deceased patients, *i. e.* somewhat less than $\frac{1}{4}$, were subject to choledocholithiasis.

3. Operations Performed.

During the years 1933—47, cholecystectomy was performed in more than $\frac{2}{3}$ of the cases of acute cholecystitis (68 out of 94 operations). The total mortality was 13 %. Decreased mortality did not appear during the last five-year period. Cholecystostomy was performed in 23 cases, 10 of which died, *i. e.* almost half. It should be mentioned that this operation was resorted to in specially bad cases. This type of operation was most common during the years 1933—37, being comparatively unusual during the last five-year period. Common bile duct incisions in the form of sounding were performed in 13 cases. In 3 cases, only laparotomy was performed.

Cholecystectomy was performed in most cases of chronic cholecystitis operated upon (635 out of 641 operations). Operations of the common bile duct (either choledochotomy or incision from the stump of the cystic duct — cholangiography or sounding) were performed in 291 of these cases, *i. e.* almost half. The total mortality in cases of cholecystectomy alone is 2 %, whereas it is 4 % in cases of common duct operations. A comparison of the mortality of these two groups yields a non-significant P value ($0.2 < P < 0.3$). The mortality in the cases of choledochotomy + drainage of the hepatic duct is 8 % (1933—47). A comparison between the mortality of these cases and that of the cases of cholecystectomy alone gives an almost significant P value ($0.02 < P < 0.05$). It has thus been established that the mortality in choledochotomy is higher in cases without obstruction of the common bile duct than when the common duct is not opened. Three out of the seven deceased cases presented abdominal complications, and one of them abscess of the liver. It should be mentioned however that the mortality in choledochotomy + drainage of the hepatic duct during the last five-year period is not higher than in simple cholecystectomy (3 and 2 % respectively). The material is comparatively small and does not allow too far-reaching conclusions. It may possibly be said that a tendency toward decreased mortality can be traced also in the case of these;

Table 4.
Operations Performed.

	1933—37		1938—42		1943—47	
	number	dead	number	dead	number	dead
A. Without obstruction.						
1. <i>Cholecystitis ac.</i>						
Cholecystectomy + drainage	9	—	27	4	19	2
Cholecystostomy + drainage	12	4	6	3	5	3
Cholecystectomy + common bile duct incision + drainage	1	1	5	—	7	2
Laparotomy + drainage ..	—	—	—	—	3	3
2. <i>Cholecystitis chron.</i>						
Cholecystectomy + drainage	84	3	93	2	167	3
Cholecystostomy + drainage	—	—	4	2	2	—
Cholecystectomy + choledochotomy + hepaticus drainage	31	3	12	2	33	1
Cholecystectomy + cholangiography or sounding + drainage	50	1	43	4	122	2
B. With obstruction.						
1. <i>Cholecystitis acuta or chronica.</i>						
Cholecystect. + choledochotomy + lithotomy + hepaticus drainage ..	43	10	37	8	71	6
Choledocholithotomy + hepaticus drainage	4	1	5	2	1	—
Cholecystect. + duodenotomy + hepaticus drainage	3	2	2	1	—	—
Cholecystect. + cleaving of the head of the pancreas + hep. drainage	—	—	1	1	—	—
2. <i>Stricture of the common bile duct.</i>						
Cholecysto- or choledochogastro- or jejunostomy ..	—	—	1	—	1	—
Plastic operation with vitallium tube	—	—	—	—	2	1

incisions. If the common bile duct is obstructed in cases exposed to choledochotomy, the mortality is twice as high (16 %) as in cases without obstruction (8 %).

In common bile duct obstruction the following operations were performed. Cholecystectomy was performed in 157 of these cases, and in 151 of these choledochotomy with extraction of the stones

was performed. The mortality in cases subjected to choledochotomy and lithotomy is high during the first two five-year periods (23 %), but a decrease is to be noticed during the years 1943—47 (8 %). Larger operations in the form of duodenotomy or cleaving of the head of the pancreas were performed in 6 cases. In 10 cases, only choledocholithotomy was performed, the cause which was the circumstance that these cases had earlier been subjected to cholecystectomy and relaparotomy. Plastic operation with a vitallium tube was performed in two cases of common duct stricture.

In all cases of cholecystectomy, a drainage was applied up toward the liver bed. The drainage was removed 2—4 days after the operation. Drainage of the hepatic duct was performed in most cases where the common duct was opened. Secondary cholangiography through the drainage tube was performed in some cases. The tube was generally removed a week after the operation.

4. *Death Causes.*

The death causes have been divided into five main groups. Abdominal complications include peritonitis (mostly diffuse) and pancreatitis. As complications from the circulation organs are counted irreversible shock and acute heart death (coronary thrombosis). Pulmonary complications have been at hand in the form of embolism, pneumonia and pulmonary abscesses. Liver changes have been at hand in the form of hepatitis, cirrhosis and abscesses. To the group of varia have been referred cases of sepsis and renal complications.

Altogether 77 patients died. Necropsy was performed on 72 of these. In the five cases not subjected to necropsy it was possible to ascertain the death cause clinically. More than $\frac{1}{3}$ of the cases suffered from abdominal complications. The second most common death cause was complications from the circulation organs and the lungs. 45 deceased patients did not present obstruction of the common bile duct. Almost half of these suffered from abdominal complications (21 cases). Liver changes were stated to be the death cause only in 2 cases. More than half the cases of acute cholecystitis (13 cases out of 22) died because of abdominal complications. In cases of common bile duct obstruction, abdominal complications are not so common (about $\frac{1}{6}$ of the cases), whereas *e. g.* liver changes are stated to be the death cause in 7 cases out of 32.

Table 5.

Death Causes.

	Abdominal compl.	Compl. from the circulation organs	Pulmonary compl.	Liver changes	Varia
<i>A. Without obstruction.</i>					
Cholecystitis acuta	13	3	4	1	1
Cholecystitis chron.	8	6	6	1	2
<i>B. With obstruction.</i>					
Cholecystitis acuta	1	—	—	—	—
Cholecystitis chron. + stricture + cirrh. paner.	6	7	7	7	4
	28	16	17	9	7

BOYCE, VEAL and McFETRIDGE (1936) gave the following death causes in their material: peritonitis — 24 %, liver death syndrome — 23 %, pulmonary complications — 17 %, shock and bleeding — 11 %, cardiorenal complications — 10 %, other causes — 15 %. WALTERS and SNELL (1940) found pneumonia to be the most common postoperative death cause at the Mayo Clinic in operations on the biliary tract. HELLSTRÖM (1942) distinguishes two main groups of death causes, one including insufficiency of the heart, pulmonary affections and embolism, whereas in the other group death is caused by infectious and toxic complications. Peritonitis was at hand in 13 out of 102 cases, and cholangitis and hepatitis in 26 out of 102 cases. BACHHUBER (1946) examined 398 deaths during a ten-year period. 33.4 % of the cases were afflicted by common duct stone, 21 % by carcinoma of the gallbladder and the bile ducts, 13.6 % by subacute or chronic cholecystitis, and 6 % by acute cholecystitis. Cholangitis was the most common death cause in cases of common duct stone, cirrhosis of the liver being the second most common death cause in these cases. The hepatorenal syndrome was at hand in 3 out of 34 cases. Postoperative pulmonary complications did not appear in these cases of common duct obstruction.

BACHHUBER found liver changes to be the death cause in the main part of the cases of common duct obstruction. The other authors mentioned do not divide their material into cases with and without obstruction, but in the investigations of BOYCE et al. and of HELLSTRÖM liver changes are the cause of death in about $\frac{1}{4}$ of the cases. In our material, liver changes constitute the cause of death in only about $\frac{1}{9}$ of the cases, but it should be observed that the main part of the cases with liver changes (7 out of 9) belong to the group of cases subject to obstruction of the common bile duct. It should be mentioned that distinct liver lesions, *e. g.*

cirrhosis, are observed in most of the cases in which liver changes are stated to be the death cause. Microscopic analysis of the liver was performed only in these cases. It is possible that the number of cases of liver changes had been greater, if all the cases of obstruction had been subjected to such analysis. Possibly some cases of *e. g.* shock or renal lesions would then have been numbered among the deaths caused by liver changes.

B. Malign Cases.

Altogether 18 cases were operated upon during the years 1933—47. Somewhat more than half of these (10 cases) suffered from carcinoma of the head of the pancreas.

According to KAUER and GLENN (1941), carcinoma of the pancreas is localized to the head of the pancreas in the majority of the cases (84 %). SCHNEDORF and ORR (1941) state carcinoma of the pancreas to be at hand in 3 % of all cases of carcinoma observed at necropsy.

2 cases of carcinoma in the papilla of Vater were found in our material. SCHNEDORF and ORR presented 10 cases; in these they found degeneration of the liver and fatty infiltration. In the present investigation, carcinoma of the gallbladder was found in 2 cases, carcinoma of the common bile duct in 3 cases, and carcinoma of the liver in one case. In the latter case the tumor was localized to the porta hepatis.

LAM (1940) states carcinoma of the gallbladder to be at hand in 4.5 % of all cases of carcinoma found at necropsy, and DICK (1939) says that carcinoma of the bile ducts is as common as carcinoma of the gallbladder.

Symptoms of total biliary obstruction were observed clinically in all our cases. WALTERS and SNELL (1940) found malignant obstruction (carcinoma of the pancreas and of the bile ducts) to produce total obstruction in 80—85 % of the cases in their material.

In 13 out of the 18 cases, palliative operations were performed in the shape of cholecysto- or choledochogastrostomy, duodenostomy or jejunostomy. In one single case a curative operation was performed in two stages, first cholecystojejunostomy and then resection of the duodenum and the head of the pancreas.

WHIPPLE, PARSONS and MULLINS (1935) and WHIPPLE (1938) use a two-stage operation in carcinoma of the papilla of Vater and of the pancreas, the first stage consisting of back-side gastroenterostomy;

ligation and parting of the common bile duct and cholecystogastrostomy. The second stage, which takes place a couple of weeks later, consists of resection of the descending part of the duodenum and excision of the head of the pancreas. BEHREND (1947) has introduced a one-stage method.

Out of the 18 cases 7 died, *i. e.* almost half. This high mortality is in accordance with that given by several authors (HUNT and BUDD 1935, OPPENHEIMER et al. 1937, and others).

The prognosis of malign cases is generally considered bad. They should be operated upon as soon as the diagnosis has been established. BERK (1941) found the main symptoms of carcinoma of the pancreas to be pains, marked weight decrease and anorexia. Physically, enlargement of the liver was at hand in 63 % of cases and palpable pancreatic mass in 37 %. Dilated gallbladder was observed in half the cases, icterus and abnormal X-ray findings in the duodenum and the ventricle in 45 % of cases. The traditional picture, with painless icterus and palpable dilated gallbladder, is observed only in 25—40 % of all cases of carcinoma of the pancreas.

Discussion.

The present investigation shows a significant decrease of the total mortality in operations on non-malign cases of the biliary tract to have taken place during the last five-year period. This mortality decrease is probably due to improved surgical technic, improved methods of anesthesia and our possibilities to prevent postoperative complications of different kinds. It should be mentioned, however, that the mortality decrease is to some extent influenced by the circumstance that in recent years a larger number of light cases have been operated upon than earlier. In spite of the decrease of the total mortality which has taken place in recent years, however, the mortality is found still to be high in certain groups of diseases. This applies above all to acute cholecystitis. The mortality in this disease is about 20 %, and no decrease is to be noticed during the last five-year period. But an almost significant mortality decrease has taken place during the years 1943—47 in cases of chronic cholecystitis both without and with obstruction of the common bile duct. In the cases with obstruction, however, mortality is still rather high. As is to be expected, the malign cases present the highest mortality of the material. In the following, the possibilities will be discussed of lowering the primary operation mortality in the cases still pre-

senting a high mortality, *i. e.* the cases of acute cholecystitis and of extrahepatic biliary obstruction.

In acute gangrenous cholecystitis the death cause is mostly complications from the abdominal organs, generally localized or diffuse peritonitis. As was mentioned introductorily, the acute cases were operated upon immediately after the arrival at the hospital or after a few days. As operation within short time is essential in these cases, no lengthy preparatory treatment of the patient can take place. It should be seen to that the fluid balance of the patient is good, and in case of shock condition whole blood, plasma or dextran should be supplied. This also applies to the postoperative stage. The adynamic ileus found in peritonitis is probably due to the patient being in a state of shock. Among others OLIVECRONA (1922), AALKJAER (1943) and EDLUND (1946) consider it probable that the shock present in peritonitis is the main cause of the fatal issue. The treatment, therefore, should first and foremost be directed against the shock. Penicillin and possibly streptomycin treatment is indicated in order to counteract the bacterial component. BEHREND (1947) in all cases of the biliary tract supplies 100,000 Oxford unities daily and 1—4 g streptomycin daily for 5 days before the operation. Among other effects, penicillin seems to act upon the *Bacillus Welchii*, which sometimes causes *e. g.* acute cholecystitis (LICHTMAN 1942). BEHREND warns against using sulfa preparations in diseases of the biliary tract, as these preparations, according to the investigations of among others REA (1941) and GREISHEIMER *et al.* (1941), seem to influence the liver, which may already be injured in affections of the biliary tract. In order to increase the resistance power of the patient in general as well as of the liver in particular, it is important to provide adequate nutrition. If the patient is unable to take food *per os*, glucose and amino acids must be supplied parenterally.

WEISS (1944) has pointed out the following essential facts: 1) that no two patients are exactly alike, and 2) that a disease seldom is limited to a single organ of the body. If the gallbladder or its ducts are affected, involvement of the liver, the pancreas, the gastrointestinal tract or manifestations in the cardiorenal vascular system may be expected. In the following, the attention will primarily be focused on the pathologic changes and the pathophysiologic disturbances appearing in the liver in diseases of the biliary tract and especially in cases where the outflow of

bile is obstructed. The pre- and postoperative treatment will be discussed against the background of the results thereby arrived at.

Clinical biliary obstruction has long been known to produce a liver lesion (STEWART and LIEBER 1934, GIBSON and ROBERTSON 1939, ROHOLM and KRARUP 1941, BACHHUBER 1946, and others). ROHOLM and KRARUP, by means of liver biopsy, have followed the development of the liver lesion in 27 cases of obstructive jaundice (16 cases of choledocholithiasis and 11 cases of carcinoma, mainly of the pancreas). Liver changes could be observed already after one day of biliary stasis, although more distinctly only after 3 days. The liver changes observed in the cases of stone and of carcinoma resembled each other, but they were stronger and more constant in the cases of carcinoma. So-called cirrhosis of the liver was not observed until after a long period of biliary stasis (180, 270 and 370 days). The majority of the authors adhere to the opinion that biliary stasis produces biliary cirrhosis (GIBSON and ROBERTSON consider cirrhosis from biliary obstruction to be a more adequate expression). HIMSWORTH (1948) points out that infection is often at hand in biliary obstruction in the shape of cholangitis with secondary liver changes—cholangiohepatitis. After prolonged biliary stasis, chronic cholangiohepatitis appears (diffuse biliary hepatic fibrosis). It may be mentioned in this connection that EDLUND (1948), in experimental partial and total biliary stasis in rats, found the liver changes to be smaller in partial than in total biliary stasis. On the whole, the liver lesion appearing in partial biliary stasis did not reach the same degree as in total stasis until after three times as long a period. In total biliary stasis, lesions of the liver cells with commencing necrobiosis could be noticed already one hour after the ligation of the common bile duct.

It has also been proved that simple cholecystitis (*e. g.* without obstruction of the bile ducts) may cause liver changes. Hepatitis has been observed in such cases (HEYD, KILLIAN and KLEMPNER 1927, FLINT 1930, BOTT and GRAY 1943 and others). EDLUND (1943 — not published), when examining a material from the Serafimerlasarettet, Stockholm, found liver changes in 17 out of 40 cases that had died after operation in acute or chronic cholecystitis (without obstruction); necropsy had been performed in 28 cases. Microscopic examination revealed subacute cholangenous hepatitis, pathologic fattening and in one case cirrhosis.

Insufficiency of the liver is often given as the cause of death in operations on the biliary tract, especially in cases of biliary obstruction. Coma or the symptom triad hyperpyrexia, anuria and coma, the so-called hepatorenal syndrome, have been observed in such cases (HEYD 1931, GRAHAM 1933, BOYCE et al. 1936, and others). BOYCE et al. (1936) state the syndrome to be the death cause in 23 % of the cases in their material. REDELL (1940) examined a Swedish material of 809 cases, about half of which consisted of carcinoma of the pancreas or the bile ducts, the rest being mainly choledocholithiasis; 653 of the patients died in connection with the operation, and he states 513 out of these to have died "without recorded complications". He considers the majority of these to have suffered from low resistance power and reduced functioning of the liver. The operation reduced the resistance power still more and caused a collapse of the functions of the liver, from which death ensued.

The pathophysiology of hepatic insufficiency does not seem to be altogether clear yet. LICHTMAN (1946) says, among other things: 1) the reduction of the functioning of the liver is not symmetric — one or several functions may be injured, the others remaining normal; 2) hepatic insufficiency may exist without demonstrable histologic changes; 3) the reserve of the liver permits destruction of a large fraction of the liver cells without insufficiency appearing, but a comparatively small lesion touching all the cells seriously disturbs the functioning capacity of the liver. EDLUND (1948) arrived at the conclusion that lack of hepatic glycogen may probably per se cause insufficiency of the liver in connection with a trauma, *e. g.* in connection with operation or narcosis. If the liver is deficient in glycogen, it lacks an energy source for its vital metabolic functions. Among other things, disturbances of the carbohydrate, fat and protein metabolism have been observed. EDLUND proved a heavy decrease of the amount of liver glycogen to appear in experimental total biliary stasis, and secondarily to this a decrease of the amount of blood sugar and hyperketonemia were observed. Also clinically a low amount of liver glycogen was observed by the same author in liver biopsy during operation in cases of total biliary stasis (carcinoma). In the experimental investigations, partial biliary stasis during a long time (12 days) was proved not to produce a decrease of the amount of glycogen in the liver. In clinical investigations performed by RAVDIN et al. (1941), the amount of liver glycogen was

not decreased in diseases of the biliary tract. No information is supplied as to whether the biliary stasis was partial or total in these cases. EFSKIND (1946) often found the amount of hepatic glycogen to be normal in cases of chronic obstructive jaundice. He finds this remarkable, as the experimental investigations would lead one to expect a decrease of the amount of liver glycogen. It is probable that the biliary stasis was only partial in the cases examined by EFSKIND, and the investigations by EDLUND referred to above show that partial biliary stasis does not reduce the glycogen store of the liver. ÅGERUP (1944), by means of liver samples taken during the operation, proved the amount of liver glycogen to be reduced in cases presenting only changes in the gallbladder. In several clinical investigations, liver biopsy before and after the operation has shown the operation to reduce the amount of liver glycogen, both in cases without affections of the biliary tract, as *e. g.* carcinoma of the gastrointestinal canal (ABELS et al. 1943) and in diseases of the gallbladder and the bile ducts (ÅGERUP 1944, EFSKIND 1946).¹ EFSKIND found patients presenting preoperative hypoproteinemia to be subject to a heavy decrease of the amount of liver glycogen during the operation. He further found patients with a low amount of liver glycogen and a high amount of liver fat to present a decreased amount of proteins in the serum after the operation.

The following summary may be given of what has been said above: 1) liver changes appear in cases of simple cholecystitis and obstruction to the outflow of bile (most markedly in total biliary stasis); 2) insufficiency of the liver is a not unusual complication after operations on the biliary tract; 3) it is not improbable that deficiency in liver glycogen may cause hepatic dysfunction or general insufficiency of the functions of the liver; 4) it has been proved experimentally and clinically that total biliary stasis decreases heavily the amount of liver glycogen; 5) operations reduce the glycogen store of the liver. A liver exhibiting pathologic changes before the operation may be injured still more during the operation. RAVDIN et al. (1943) have shown that degeneration of the liver and necroses may appear, especially in "bad risks", in operations on the biliary tract.

In our opinion, it is important pre- and postoperatively to

¹ Experimentally it has also been found that laparotomy together with operation on the common bile duct produces a decrease of the amount of glycogen in the liver (EDLUND 1948).

increase the resistance power of the liver against the insults it is subjected to in the shape of operations and anesthesia. It is possible by means of a therapy of this kind to increase the functioning latitude of the liver and thereby to prevent a collapse of its functions. RAVDIN and co-workers (1941, 1943), have stressed the importance of supplying proteins to the organism preoperatively in order to protect the liver. They deny the importance of a therapy aiming at increasing the glycogen store of the liver (food rich in carbohydrates). EDLUND (1948), on the other hand, on the basis of his experimental investigations, considers a treatment that aims at increasing the amount of liver glycogen to be of the greatest importance, although such treatment or supply of amino acids provides no protection against the pathologic changes in the liver appearing in biliary stasis (it was thought earlier (RAVDIN 1929, BERNHARD 1931) that administration of glucose prevents liver changes in experimental biliary stasis). EDLUND proved a disturbance of the phosphorylation processes of the liver to be at hand in total biliary stasis. If a small amount of glucose (0.2 g/100 g body-weight) was given daily to the animals (who had ordinary food), the amount of liver glycogen did not increase, but it did increase if a daily dose of 0.6 g/100 g body-weight was administered. These experiments prove the importance of supplying a sufficient amount of substrate for the achievement of an increase of the amount of liver glycogen. If a sufficient amount is supplied, the break-down of glucose can get started in spite of the weak phosphorylation activity. As soon as the break-down processes have started, more phosphate bindings are produced than are used in the phosphorylation of carbohydrates. The synthesis of ATP (adenosin triphosphate) starts and glycogen can be formed. What is interesting is that the administration of only 1 mg ATP or 3 mg fumaric acid/100 g body-weight daily parenterally produces the same increase of the amount of liver glycogen as if 600 mg glucose/100 g body-weight were administered. No clinical experience has as yet been won as to this form of therapy in the preoperative treatment in diseases of the biliary tract. As to the supply of glucose in clinical cases, it should be mentioned that the experimental experiences described show that it is necessary to supply sufficiently large amounts of glucose in the pre- and postoperative stages in order to achieve an increase of the amount of liver glycogen. If possible, the patient should be given food that is rich in carbohydrates and also proteins. Supply of

proteins is namely necessary pre- as well as postoperatively in cases of the biliary tract, as hypoproteinemia is not an uncommon occurrence in these cases (SNELL 1935, STEWART 1940, WALTERS and SNELL 1940, WUNDERLY and WUHRMAN 1947, and others). Decreased amount of proteins in the serum may produce edema in the intestine, causing reduced motility (JONES and EATON 1933, and others). The motoric activity, which is reduced reflexly by laparotomy, may thereby be deteriorated still more, and an ileus syndrome may develop. The pre- and postoperative treatment should among other things, aim at counteracting dehydration, chloropenia and hypoproteinemia and at increasing the functioning capacity of the liver by producing an increased amount of liver glycogen.

The importance of supplying a sufficient amount of substrate for the achievement of an increase of the amount of liver glycogen was mentioned above. WEISS (1944) administers 1,500 ml 20 % glucose postoperatively during 10—15 hours in diseases of the biliary tract. He mentions that so strong a solution of glucose may sometimes produce venous thrombosis. In order to obtain nitrogen balance he administers 75 g amino acids and 100—200 ml plasma. PAREIRA and SOMOGYI (1948) point out that postoperative administration of glucose serves two objects: to prevent starvation ketosis and to decrease the protein catabolism by saving proteins. Ketosis always appears if lack of liver glycogen is at hand. EDLUND (1948) proved total biliary stasis with heavily decreased amount of liver glycogen to produce hyperketonemia. PAREIRA and SOMOGYI consider ketosis to cause a progressive deterioration of the architecture of the liver cells as the ketone bodies change the concentration of hydrogen ions and the electrolyte pattern of the cells. These changes disturb the enzymatic reactions and the immunologic functions of the liver. The authors mentioned are of the opinion that not less than 200—350 g glucose should be administered postoperatively during 24 hours. The concentration of the glucose solution should be 10 %. Increased tendency toward development of thrombosis was not observed when a solution of this concentration was given, nor increased diuresis.

WALTERS and SNELL (1940) consider the surgical risk in operations on the biliary tract to depend exclusively upon the ability of the liver to maintain physiologic conditions during the pre- and postoperative period. BEHREND (1947) says: "Probably

no patients upon whom the surgeon is called to operate face more danger than those with cholemia." He recommends a diet rich in carbohydrates in order to bring about storing of glycogen in the liver, but poor in proteins and fat. Preoperatively, dehydration should be counteracted and whole blood or plasma supplied. He points out that the preoperative glucose treatment has decreased the number of deaths due to hepatic dysfunction. Several other authors are of the same opinion (DE COUREY 1937, WALTERS and SNELL 1940, KIRSCHNER and NORDMANN 1942, and others). BEHREND further says that vitamin K and bile salts should be supplied in cases of jaundice. Others, *e. g.* LICHTMAN (1942), say that administration of bile salts is not to be recommended because of the toxic effect that they may produce in this condition. Experimentally, however, it has not been possible to prove them to produce toxic effects (IVY 1941, EDLUND 1948). Supply of bile salts must be considered to be indicated in total biliary stasis, as the resorption of fat and fat-soluble vitamins is improved by it. In partial biliary stasis, however, there is a theoretic possibility that the bile acids may cause increased choleresis and thereby accumulation of bile above the obstruction, with increased pressure in the bile ducts as a result, and this may increase the liver lesion (EDLUND 1948).

By way of summarizing, we would like to give the following recommendations, on the basis of the viewpoints given above, as to the pre- and postoperative treatment of cases of extrahepatic biliary obstruction. Dehydration and chloropenia, if present, are to be treated. Whole blood, plasma or dextran is supplied in case of shock. Oxygen inhalation is thereby also valuable.¹ Vitamin K is administered per os or parenterally. In some cases the hypoprothrombinemia is not influenced although vitamin K is supplied, due to liver lesion. LICHTMAN (1942) is of the opinion that the vitamin K therapy should be continued all the same with a special view to applying an intensive intravenous glucose therapy, multiple blood transfusions. Preoperatively, hypoproteinemia is counteracted by supplying food rich in proteins or amino acids parenterally. EDLUND (1948), in his experiments with total biliary stasis, showed that amino acids counteract the glycogenetic capacity of the glucose when these two substances are administered simultaneously. He therefore considers that the protein need of

¹ Bile salts shall be given pre- and postoperatively (preoperatively possibly not in partial biliary stasis).

the organism should be satisfied in the first place by supplying food rich in proteins or amino acids parenterally, and later, in connection with the operation, food rich in carbohydrates should be supplied with addition of glucose per os or parenterally. It may be mentioned that according to experimental investigations (EDLUND, 1948) parenteral administration of glucose in total biliary stasis must be considered safer than enteral. In the first case one is independent of possibly existing resorption disturbances in the intestine and also of possibly existing disturbances of the portal circulation. The same treatment is applied postoperatively, but at least during the first days after the operation the carbohydrates and to some extent also the proteins must be administered intravenously. We are as yet unable to present any results with parenteral administration of ATP or fumaric acid in order to increase the amount of liver glycogen.

At last the choice of anesthesia, especially in cases of obstruction of the common bile duct, will be discussed. If possible, anesthetics that produce liver changes or a heavy decrease of the amount of liver glycogen should be avoided. Inhalation narcotics, such as chloroform and ether, may reduce the amount of liver glycogen and cause liver lesions (ROSENBAUM 1882, SEELIG 1905, EVANS, TSAI and YOUNG 1931, RAVDIN et al. 1938 and others). Full narcosis with these is thus not to be recommended. Furthermore, in operations of long duration ether produces dilatation of the capillaries and thereby causes shock (BOHMANSOON 1936, AALKJAER 1943). As to intravenous narcotics (barbituric acid preparations), *e. g.* Pernokton and Amytal reduce the amount of liver glycogen (MURPHY and YOUNG 1932). Several authors are of the opinion that Evipan and Eunarkon narcosis should not be applied in cases of liver lesion (VOGT 1935, ÅKERBLOM 1937, DE GIRONCOLI 1939, and others). EDLUND (1942) using Narkotal¹ in experiments on mice, found it not to decrease the amount of liver glycogen or to cause liver lesions when administered once in a moderate quantity. Later (1948), the same author, using normal rats in his experiments, found that one hour of Numal narcosis did not decrease the amount of liver glycogen. Barbituric acid derivatives in the form they are used in nowadays, *i. e.* mainly as a means of putting the patient to sleep in connection with inhalation narcosis, cannot be considered harmful in the small dose that is given, even if a liver lesion is at hand.

¹ Eunarkon is manufactured in Sweden under the name of Narkotal.

SNELL (1935) has proved anoxemia to be at hand in clinical biliary obstruction, with reduced ability of the hemoglobin to absorb oxygen. In anoxia, anoxemic or anemic, a liver lesion appears with atrophy of the central parts of the lobules (ROSIN 1939, RICH 1930). If the liver is injured before the operation and narcosis, inhalation narcosis excluding the possibility of supplying oxygen simultaneously may injure it still more by anoxia (GOLDMAN and BELL 1941, and others). Since half a year, in 200 larger or smaller abdominal operations, $\frac{1}{6}$ of which were operations on the biliary tract (some with obstruction of the common bile duct), we have used a method of anesthesia in which Narkotal and nitrous oxide were given as narcotics with addition of curare for relaxing the muscles. The technic was briefly the following: Premedication in the usual way, generally with morphine-scopolamine. Narcotizing of the patient to the second plane by means of Narkotal, and after that addition of nitrous oxide and oxygen according to the carbon dioxide adsorption method in a half-closed system with narcosis apparatus. At the beginning of the operation injection of 50—70 mg curare (Intocostirin or d-tubocurarin Squibb), sometimes followed by a smaller dose after 3—5 minutes, when the muscles are generally completely relaxed. Small amounts of Narkotal and about 0.5 l N_2O + 0.5 l oxygen were supplied during the operation. The advantages of this method are that only small amounts of narcotics are needed, a high proportion of oxygen can be maintained during the entire operation, quick awakening is obtained, and as far as we have been able to judge up to now, postoperative complications appear only to a small extent. There are also disadvantages, above all risk of cessation of the breathing if the dose of curare is too large, but this occurred only in two cases and was easily mastered by artificial breathing without or after intubation. The comparatively small amounts of Narkotal supplied do probably not decrease the amount of liver glycogen (cf. the investigations of EDLUND referred to above). The information available differs as to whether curare influences the carbohydrate metabolism. Among others MAGNE (1913) and MC INTYRE (1947) consider curare to cause hyperglycemia due to disturbed glycogenesis and increased glycogenolysis. Among others LUCHSINGER (1875), on the other hand, found no glycosuria after administration of curare. There does not seem to be any clinical investigations on the effect of curare on the glycogen of the liver. We have found the method described above to

present some advantages and as far as we have been able to judge up to now no higher mortality postoperatively in operations on the biliary tract than *e. g.* spinal anesthesia. In the majority of the cases in the material presented above, however, spinal anesthesia by means of percaine was used. This method in surgery of the biliary tract is recommended by several authors (BOYCE et al. 1936, RAVDIN et al., and others).¹ There are, however, some disadvantages connected with it. It is contraindicated if the patient is in a state of shock before the operation, *e. g.* in peritonitis. It has further been proved that complications from the central nervous system appear immediately or later after spinal anesthesia. These complications are considerably more frequent than is generally assumed (THORSÉN 1947). We are therefore more inclined to use combination narcosis with curare than spinal anesthesia. We do not venture as yet to express an opinion as to whether the former method implies greater risks than the latter in the "bad risks" that are generally at hand in obstructive jaundice, as the material of comparison is too small.

Summary.

The present investigation gives an analysis of a surgical biliary tract material. The material consists of cases of the biliary tract operated upon during the years 1933—47 at the hospital of Falun. The main part consists of 899 non-malign cases, the rest being 18 malign cases. The points 1—9 below give a summary of the results obtained in the non-malign cases, whereas point 10 concerns the malign cases.

1) The total mortality during the last five-year period (1943—47) is significantly lower than during the years 1933—42.

2) The mortality of males is higher throughout than that of females (twice as high) during the three five-year periods (1933—37, 1938—42, 1943—47).

3) The total mortality is highest in the case of patients above the age of 60 (24 %).

4) The mortality in acute cholecystitis is high (about 20 %), and decreased mortality is not observed during the last five-year period.

¹ Spinal anesthesia has been found to cause hyperglycemia of short duration by means of influence on the central nervous system (KALBAL 1938).

5) The mortality is low throughout in chronic cholecystitis, and the mortality decrease is almost significant during the last five-year period (2 %).

6) The mortality in obstruction of the common bile duct (chiefly in the form of stone) is high during the first two five-year periods (26 %), but an almost significant decrease of the mortality is observed during the years 1943—47 (9 %).

7) Choledochotomy in cases without obstruction of the common bile duct produces a higher mortality (almost significantly) than cholecystectomy alone. The mortality is 8 and 2 % respectively.

8) Choledochotomy in obstruction of the common bile duct produces a mortality that is twice as high (16 %).

9) The cause of death in acute cholecystitis is abdominal complications (generally diffuse peritonitis) in more than half the cases. In cases of obstruction of the common bile duct the cause of death is liver changes in about $\frac{1}{4}$ of the cases.

10) Out of the 18 malign cases operated upon (more than half of which consisted of carcinoma of the head of the pancreas), 7 died. Palliative operations were performed in 13 of the cases, a curative operation being performed only in one case.

11) On the basis of the results arrived at and the experience of earlier authors, recommendations for the pre- and postoperative treatment of cases of obstruction of the bile ducts are given. The mortality in these cases is still comparatively high, although it has decreased in recent years. Among other things, the importance is emphasized of counteracting a heavy decrease of the amount of liver glycogen in connection with the operation and in the postoperative stage, as it was considered not improbable that deficiency in liver glycogen per se may cause a collapse of the vital metabolic functions of the liver (hepatic insufficiency).

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Hypersplenism in a Patient with Lympho- granuloma Benignum.

By

ROLF CARLESON and INGMAR BERGSTRÖM.

"The spleen is an organ full of mystery." This statement is still valid despite the fact that during recent years a number of works have been published which — although they are partly founded on hypotheses — have afforded possibilities of a better understanding of the significance of the spleen. Of its many functions, it is probably that which concerns the blood picture that has attracted the greatest interest. There appear to be two schools of thought. According to one, represented by KAZNELSON, DOAN and WISEMAN, the effect of the spleen on the blood picture is only that of local breaking down and phagocytosis. The other — that of ISAAC, ENGELBRETH-HOLM and DAMESHEK — assumes the existence of one or more splenic hormones. It is beyond the scope of the present paper to enter into the interesting discussion of the reasons for and against these theories. Many facts, however, speak in favour of the theory of hormones as the most likely one. According to it, the spleen by means of its hormones exercises an inhibitory effect on haematopoiesis in the bone marrow, presumably in the form of a block between the marrow and the blood. DAMESHEK et al. further postulate that an anatomical enlargement gives rise to a physiological hyperfunction. The clinical result would be that, in the event of an enlarged spleen, an increased activity in this organ must be envisaged.

As long ago as 1919 MORAWITZ and EPPINGER introduced the term hypersplenism for the hyperfunction of the spleen. New

actuality was given to it by DAMESHEK. An accentuated inhibition of the bone marrow can be partial and affect the system of the red blood corpuscles (R. B. C.) or that of the white ones (W. B. C.) or that of the platelets (T.), or combinations of them. It can also be total. In hypersplenism there can thus be varying

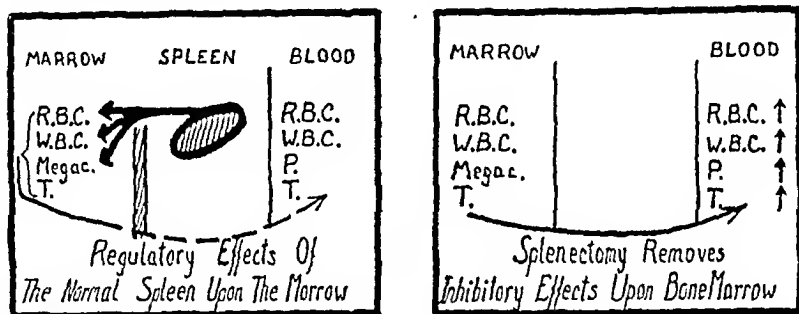


Fig. 1.

pathological pictures, with anaemia, granulocytopenia or thrombocytopenia. In the total form all the forementioned poieses are inhibited with resulting pancytopenia.

Hypersplenism can, however, occur without any enlargement of the spleen. Thus, essential thrombocytopenia is considered to be an expression of the partial inhibition of the bone marrow although in such cases the spleen is often normal in size.

Hyposplenism can also occur. It has been observed in the extremely rare instances of splenic atrophy. The purest form is obviously found following splenectomy. There is then an increase in the number of erythrocytes, granulocytes and thrombocytes and — as an expression of the cessation of the control of denucleation — red blood corpuscles containing Howell-Jolly bodies. In addition, there is an increase in the osmotic resistance of the red blood corpuscles.

Shortly, one can sum up, as DAMESHEK and ESTREN, the theories and the facts of the relations between spleen, bone marrow and blood thus: The normal spleen is interposed between the blood and the marrow. It secretes a hormone or hormones which regulate growth and delivery of marrow cells. Splenectomy removes normal slight "block" between marrow and blood (Fig. 1). The enlarged spleen secretes an excessive amount of a hormone or hormones causing, among other effects, a marked "block" between marrow and blood resulting in various types and degrees of cytopenias. (Fig 2.)

Under normal conditions there is a balance between the production and the destruction of the formed elements in the blood.

The spleen, as a part of the reticulo-endothelial system, is of considerable importance in this function as well. During the passage of the blood corpuscles through the venous sinusoids, old and used-up erythrocytes are presumably withdrawn from circulation and broken down. According to R. FÄHRÆUS and B. BERGENHEM

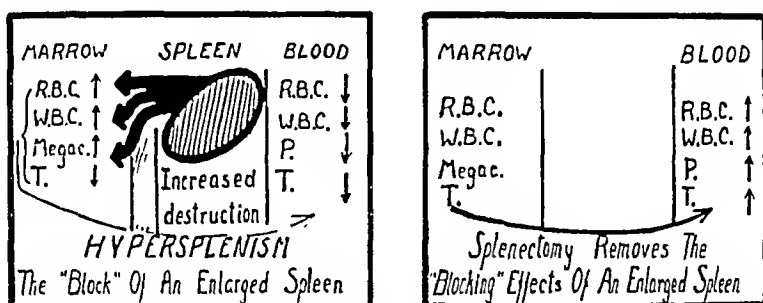


Fig. 2.

this destruction is caused by a lysolecithin effect upon the erythrocytic membrane. Splenomegaly can be accompanied by increased destruction with the well known haemolytic symptoms of hyperbilirubinaemia, haemoglobinaemia, haemoglobinuria and increase in the faecal urobilin. In this connexion it can be of interest to mention the statement made by W. J. MAYO, *i. e.* that in patients with an increased destruction of the blood there is a remarkably high percentage (60—70 per cent) of pigment concretions in the bile ducts.

Decreased osmotic resistance and spherocytosis are parallel phenomena but are not inevitably connected with splenic dysfunction. Spherocytosis can, however, be an indication of an "intrinsic" defect in the blood corpuscle system itself. This is presumably the case in familial haemolytic icterus. It is of importance to realize that spherocytosis in conjunction with a normal or enlarged spleen gives rise to haemolysis whereas spherocytosis and the absence of the spleen does not. In the former cases satisfactory effects are obtained by splenectomy although there is no primary splenic diseases. "Extrinsic" factors such as agglutinins, haemolysins and certain chemical substances such as sulpha drugs can also cause spherocytosis.

It is usual to find reticulocytosis in splenogenic anaemias. This is nevertheless nothing more than an indication that erythropoiesis is increased. It can thus be an indirect symptom of hypersplenism in which puncture of the bone marrow most frequently reveals hyperplastic erythropoiesis.

Splenic anaemia is thus not haemolytic when there is only marrow inhibition, but is haemolytic when there is morbid destruction of the erythrocytes with or without concomitant marrow inhibition. It is presumably a question of a difference of degree rather than of nature. The general rule would appear to be that in acute cases, such as haemolytic crises and Lederer's anaemia, haemolysis predominates whereas in chronic conditions bone marrow inhibition is the main feature. Hypersplenism should thus become a wider definition to include accentuated bone marrow inhibition and increased destruction of the blood corpuscles.

It should be borne in mind that hypersplenism is a functional and not a histopathological disturbance, a syndrome and not a disease *sui generis*. Every affection, either local or general, which is accompanied by splenomegaly can give rise to hypersplenism. The clinical picture can therefore vary, depending on the other symptoms of the basic disease.

A case of secondary hypersplenism has recently been observed at Serafimerlasarettet. The patient was a 34-year-old woman, who was admitted to the Surgical Department on 1. 6. 1948 with the picture of an acute abdominal disorder. Publication of a report of the case seems justified not only from the point of view of the syndrome in question but also with regard to the peculiar case-history and the considerable diagnostic difficulties encountered during her present and earlier stays in hospital.

Extract from the case-sheet (Surgical Dept. no 1313/1948 and Medical Dept. no 876/1948): Female, born 1914.

Heredity: nothing of interest. The patient is no. 4 of 7 siblings. The others are healthy. Menstruation of the type 3—4/28 days, normal. Previous illnesses: delicate as a child.

1924: treated at her local hospital for *chronic pyelitis*. Since then intermittent pain in the right lumbar region and downwards towards the groin, particularly when exposed to cold. Fever also present during these attacks.

1937: treated at the Medical Department of Serafimerlasarettet during an icterus epidemic for *acute hepatitis*. Amongst other symptoms, the urine was then dark. Discharged healthy.

1939: admitted to hospital for *pregnancy, chronic pyelonephritis, hypoplasia of the right kidney, cholelithiasis and pernicious anaemia*. Her condition was considered to justify artificial abortion. Shortly after the intervention her condition deteriorated with a rise in temperature, icterus and a decrease in the blood counts to as low as R. B. C. 2.5 millions and Hgb. 49 per cent. Hijmans van den Bergh reaction

was positive. During her stay in hospital she had three attacks of biliary colic. Liver preparations and iron were given for anaemia with a satisfactory effect on the blood picture. She was subsequently relatively healthy.

1944: she once more became ill with *icterus and fever* and was admitted to the same hospital. Pronounced icterus and amongst other symptoms splenomegaly were found. Hgb. 58 per cent, R. B. C. 2.8 millions, Meulengracht 1/22. Hijmans van den Bergh reaction was negative direct and positive indirect. During hospitalization pain in the right region of the abdomen and a rise in temperature several times. Operation: *cholecystectomy*. No concretions in the common bile duct but a number of black concretions in the gall-bladder. Following the operation icterus and tenderness over liver and spleen. Following discharge from hospital there was a period free from discomforts until:

1946: when there was an attack of *icterus, fatigue and fever*. She was admitted to the local hospital where amongst other findings the following were made: Liver palpable immediately below the arcus. Spleen 3 cm below the arcus. Meulengracht 1/25—1/10. Liver functional tests normal. Normal erythrocyte resistance. Sternal puncture normal. Liver puncture revealed miliary granulomatosis (? tuberculosis ? Schaumann's disease). No tubercle bacilli could be demonstrated. The patient gradually recovered without therapy.

1947 (Spring, thus a few months later): she had a fresh attack of *pain in the right side and dark-coloured urine*. She was once more admitted to hospital. Hgb. 33 per cent, R. B. C. 1.0 million and pyuria with *B. coli*. The anaemia gradually regressed with the help of blood transfusions. Altogether 4.5 litres of blood were given without any complications.

1948: she once more became ill with *pain in the right side of the abdomen*, radiating downwards into the right groin, vomiting and dark urine. She was admitted to the Surgical Department of Serafimerlasarettet after an acute exacerbation of the forementioned symptoms during the preceding 24 hours.

Examination: Female, aged 34. Asthenic build. Somewhat dehydrated. Temp. 38.3° C. Pulse 108/min. No changes in the skin or pigment. No changes in the nails or fissure at the corner of the mouth. No enlarged lymph nodes palpable. Neurological examination N. A. D. Oral cavity, fauces, thyroidea, lungs and heart N. A. D. Blood pressure 115/70. Abdomen: normal configuration, slight muscular rigidity in the right half, moderate tenderness on the right with a maximum over the right kidney and below the right costal margin. No definite enlargement of the liver on percussion. Lower pole of the spleen palpable two finger-breadths below the arcus. Otherwise no resistance. Gynaecological examination: normal conditions. Urine: N. A. D.

Appendicitis suspected. The symptoms nevertheless regressed gradually during observation. The patient was given 1 litre of physiological NaCl intravenously after admission.

After a day or so distinct icterus developed with Meulengracht 1/40. This gradually fell to a normal figure. The blood counts fell rapidly

from Hgb. 77 per cent, R. B. C. 4.0 millions, W. B. C. 6,800 to Hgb. 56 per cent, R. B. C. 2.8 millions, W. B. C. 3,400.

Urological examination revealed coluria, proteinuria and a hypoplastic, poorly functioning right kidney with a calculus. The radiograms (intravenous urography, retrograde pyelography, aortography) from the left side appeared to indicate an expansive process. Aortography also showed moderate splenomegaly.

The patient was transferred to the Medical Department for further observation. During her stay there she improved slowly but there was no complete remission of the anaemia.

Liver tests: Further study of earlier liver puncture: same results as previously, i. e. granulomatosis with a miliary structure, origin uncertain. Ehrlich: negative—traces. Sehlesinger: negative—+ (+). Liver function otherwise N. A. D.

Blood: Sternal puncture: marked hyperplastic erythropoiesis with pronounced disturbances in maturation and increase of the reticular cells. X-ray examination of skeleton (hand, foot, spine, pelvis, hip joints, skull): nothing noteworthy. R. B. C., reticulocytes, Meulengracht and bilirubin, Hgb., W. B. C. and thrombocytes: v. fig. 3 and the table. E. S. R. normal. Serum-proteins normal. Oxihæmoglobin in serum and urine: negative in repeated tests. No porphyrinuria.

Hijmans van den Bergh reaction (repeated tests) direct, negative after 4 minutes; indirect, immediately positive. Osmotic resistance: (repeated determinations according to various methods) normal. Erythrocyte diameter: average diameter 7.22—7.48 μ , anisocytosis. Lymphocyte diameter according to KRISTENSON: shift to the right as in tuberculosis and Schaumann's disease. Bleeding time, coagulation time, clot-retraction normal. Quantitative urobilin in urine 3.6 mg per 24-hour volume. Donath-Landsteiner's reaction: negative. Blood cholesterol: 129—169 mg per cent. Rh determination: patient A 1 Rh+, patient's mother A 1 Rh+.

Renal and urinary tract tests: Creatinine clearance 64.4 ml/min. Addis' count: 1.5 million R. B. C., 21 millions W. B. C. Heller positive on a few occasions, mainly negative.

Other tests: Mantoux negative for 1 mg. X-ray examination of lungs: N. A. D. X-ray examination of stomach: N. A. D.

Investigations for the presence of tubercle bacilli: negative. Sample biopsy from tonsils: chronic tonsillitis, no signs of tuberculosis, Schaumann's disease or tumor. Splenic puncture (NORDENSON): reactive changes of non-specific type, no signs of extra-medullary blood formation. No contra-indications for splenectomy on the basis of the puncture.

The tests were considered to support the suspicions of splenogenic anaemia, although no direct signs of hæmolysis could be noted. No contra-indications to splenectomy were considered to exist. The patient was therefore again transferred to the Surgical Department for operation.

Operation (CARLSON): 11. 8. 1948. *Splenectomy + sample biopsy from liver margin.* (Anaesthesia: "Narkotal" + N₂O + O₂ + eurare.)

Incision in the medial line above the umbilicus with a shank laterally in the lower angle. Spleen definitely enlarged and was found to weigh 660 g. No perisplenic adhesions. Slight coating of fibrin on the convexity, presumably due to splenic puncture. Ligation of the vessels beside the hilus. Splenic artery considerably thicker than normally. No stasis in the porta hepatis area. The liver was completely normal in appearance and size. A small wedge was excised from the margin of the left lobe. No enlarged lymph nodes in the retroperitoneal region. No cyst nor tumor could be felt in the left kidney, which seemed to be completely normal and possibly somewhat larger than usual. Primary suture.

Biopsy (Å. LINDGREN): Slight diffuse fibrosis in the spleen and pronounced haemosiderosis and stasis. In addition, numerous tubercles, in some places in groups and in others with giant cells but no caseation. Haemosiderosis in the liver as well. Single submiliary tubercles of similar type to those in the spleen in the periportal connective tissue which is not increased but slightly infiltrated with round cells. Haemochromatosis + miliary tuberculosis (possibly Schaumann's disease). Further examination: despite lengthy search in specially stained specimens no tubercle bacilli can be demonstrated. This fact, in conjunction with the case-history appears to indicate that the patient is suffering from Schaumann's disease.

In connexion with the operation 450 cc of blood were given as well as physiological NaCl as a slow intravenous infusion. The postoperative course was free from complications and the patient could be discharged shortly afterwards.

She was re-admitted on 11. 10. 1948 and had then improved considerably. She stated spontaneously that she had never hitherto, as far as she could remember, felt so strong and healthy and energetic. Blood count: Hgb. 88 per cent, R. B. C. 4.4 millions.

Renewed renal examination with aortography revealed a large, normally functioning left kidney which following splenectomy lay higher up and no longer showed any signs of an expansive process. The right kidney had only a small excretory parenchyma the size of a walnut in the superior part and a dilated renal pelvis with calculus. Blood pressure 110/75.

Operation (CARLSON): 20. 10. 1948. *Right-sided nephrectomy + sample biopsy of a lymph node.* (Anaesthesia: ethyl chloride + ether.) The kidney was the size of the tip of the thumb, weighed 30 g, was embedded in infiltrated tissue, and the renal parenchyma only remained in the most superior pole. A concretion the size of a bean was found in the hydronephrotic renal pelvis. Beside the renal blood vessels and retroperitoneally were a number of enlarged lymph nodes, of which one was removed for biopsy. Primary suture.

Biopsy (FALCONER): Schaumann's disease in the kidney and the lymph node with possible hydronephrotic atrophy of the former.

The postoperative course was normal and the patient was remarkably little affected. The coluria cleared up following streptomycin therapy. The patient was discharged in good general condition with

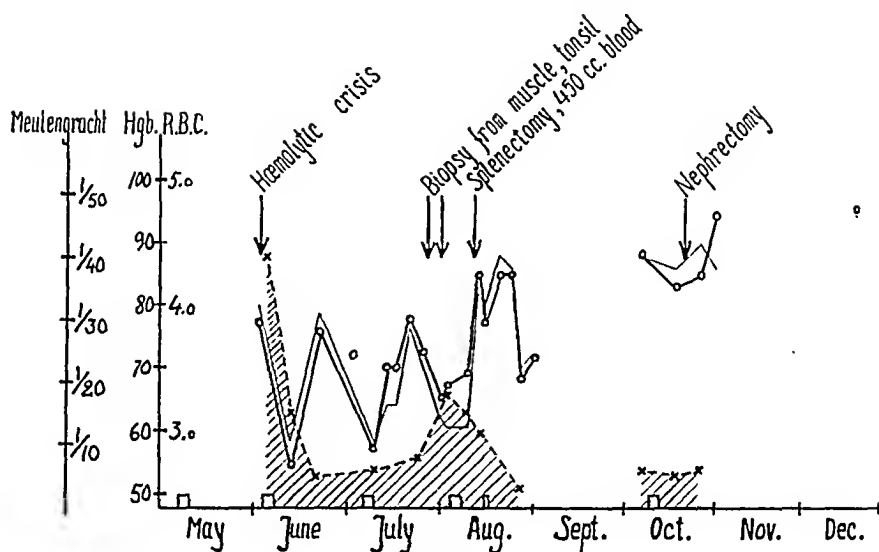


Fig. 3.

The thin undotted line = R.B.C. The thick undotted line = Hgb. The dotted line = Meulengracht. The cubes on the abscissa denote the date of menstruations.

Hgb. 95 per cent, R. B. C. 4.3 millions. There was no rise in the bilirubin index in connexion with the operation.

To sum up, the patient was a woman who suffered from repeated pains in the right side of the abdomen, usually accompanied by chills and icterus, varying anaemia, at time severe, possible slight enlargement of the liver (earlier liver punctures appeared to show uncertain granulomatosis), splenomegaly and signs of renal disorder, thus a somewhat puzzling picture. It was nevertheless possible from these symptoms and from the results of the tests to distinguish some details as a guide to therapeutic measures. The splenomegaly, pancytopenia, the findings in the bone marrow and the hyperbilirubinaemia were links which when assembled showed that the patient suffered from the syndrome of hypersplenism. The results of Hijmans van den Bergh's test also pointed in the same direction, although they are of less importance since the reaction can be unspecific. The etiology was as yet uncertain. It was difficult to perceive any connexion with the renal disorders or the changes in the liver. Nevertheless, the indications for operation — of main importance for the patient — were definite. Splenectomy was performed without complications and with an immediate improvement in the blood picture, thus in accordance with the theory of hypersplenism. On

examination of the specimens taken at the operation, the pathologist was able to provide the final solution regarding the origin of the complicated case, *i. e.* in lymphogranuloma benignum.

It is instructive to study afterwards a case that from the beginning was so puzzling. A plausible explanation can be obtained for the entire picture of symptoms.

Changes characteristic of those in Schaumann's disease were found in the liver, spleen, kidney and lymph nodes. It is not known how and where they began nor, with any certainty, their patho-physiological importance. They nevertheless gradually gave rise to splenomegaly and the possibilities of hypersplenism. They can — possibly on the basis of a congenital malformation — have caused the right kidney to be a site of less resistance. Urinary tract infections, renal calculus and acute pyelitis developed. An earlier slight or latent hypersplenism became accentuated or manifest owing to the extra load on the organism caused by the infections. Attacks of haemolysis with anaemia and icterus occurred. A rise in the serum bilirubin with increased destruction of the blood was a predisposing factor for biliary calculi. The pain was due to pyelitis and renal calculi, biliary calculi and haemolytic crises with a somewhat varying picture.

Surgical interventions — induced abortion, cholecystectomy and possibly sample biopsies — in addition to the infections gave rise to exacerbations of the hypersplenism and fresh haemolytic crises. Following splenectomy, the blood became normalized with a transition to the picture found in hyposplenism. The patient tolerated a subsequent operation, *i. e.* nephrectomy, well. This would scarcely have been possible before splenectomy. The extirpation of the kidney thus became a true functional test of the organism which no longer reacted in a hypersplenic manner. Both the objective and the subjective improvement were marked. A recent statement from the patient more than four months after the splenectomy shows that the improvement is still maintained (*v. table*). The fact that the basic disease persisted can not, therefore, be considered to have diminished the value of splenectomy.

Surgical intervention is the only effective therapeutic measure in the majority of cases of hypersplenism. One absolute contraindication to splenectomy exists, *i. e.* extramedullary formation of blood when the spleen returns to its foetal function. There are two different forms of this condition. In the first, splenic

formation of blood is compensatory, as in osteosclerotic anaemia e. g. in widespread bone marrow metastases. The second form, so-called erythroblastosis in adults or Emile Weil's "*maladie érythroblastique de l'adulte splénique ou splénohépatique*", is very similar to the leukaemias but is characterized by a very pronouncedly chronic course. In such cases there are usually immature red and white blood corpuscles in the circulating blood although the bone marrow is hypoplastic. Very difficult to diagnose are those rare cases of krypto-erythroblastosis with no immature cells in the blood. Splenic puncture is necessary in order to exclude such cases with certainty.

Splenectomy is as a rule unsuitable in leukaemia, lymphosarcoma, Sternberg's disease, Machiafawa-Michell's paroxysmal nocturnal haemoglobinuria, subacute bacterial endocarditis and malaria. Cases have nevertheless been reported in which the operation was successful in patients with the forementioned diseases, provided that there were marked signs of hypersplenism and that the patients' condition did not otherwise contra-indicate the intervention.

Splenectomy presents as a rule no technical difficulties. It is, nevertheless, worth while to point out that the expected effect on the blood picture has at times been lacking or has been transient although definite hypersplenism was present. A possible explanation is regeneration from residual splenic tissue or functioning accessory spleens. Accessory spleens are considered to exist in 11—35 per cent of cases.

Lymphogranuloma benignum is a not uncommon cause of splenomegaly, a fact well known to pathologists. The changes have nevertheless often been mistakenly interpreted as tubercular and sufficient importance has not been attributed to their pathophysiological effects.

SECRETAN in 1917 described a case of Banti's syndrome in which biopsy of the spleen revealed "large-celled tuberculosis". GEBSATTEL (1920) observed a similar case with the diagnosis of "atypical tuberculosis" after biopsy. ASKANASY (1921) reported another case with the diagnosis of Banti's syndrome on a chronic tubercular basis, etc. Further study of the clinical data in these and similar cases gives reason to assume that it was actually a question of lymphogranuloma benignum. Signs of hypersplenism were also undoubtedly present in a number of the cases. Splenomegaly is usually moderate but the organ can sometimes become

enormous. JAMES and WILSON described such a case in which spontaneous rupture occurred.

The majority of the cases reported of visceral lymphogranuloma benignum showed changes in the skin, the lymph nodes or the lungs on which the diagnosis could be based. In the case described here it was more difficult to establish a diagnosis since the skin and lung changes were lacking, the X-ray examination of the skeleton was normal and there were no typical changes in the tonsillar tissue. An almost parallel case is included in DAMESHEK's series and a short mention of it is therefore justifiable here.

The patient was a 41-year-old woman who had suffered from weakness and fatigue. Examination revealed enlarged axillary lymph nodes, enlarged spleen, slight pulmonary changes visible radiologically and normal findings on puncture of the bone marrow. The blood counts were: Hgb 57 per cent, R. B. C. 3.9 millions, W. B. C. 3,100 of which 2,200 polynuclears, and a decreased number of thrombocytes. After splenectomy the blood counts rose to Hgb. 100 per cent, R. B. C. 4.5 millions, W. B. C. 12,900 of which 10,700 polynuclears, thrombocytes normal in number. The diagnosis was: Sarcoidosis — Splenomegaly — Hypersplenism — Pancytopenia.

Finally, it can be stated that the term hypersplenism has cleared a path in the jungle which splenic diseases have hitherto constituted. Directives for making a diagnosis have been afforded. The therapeutic possibilities have become clearer. It has become possible to establish the indications for splenectomy with greater certainty. In this connexion a close collaboration between the physician and the surgeon is both necessary and of mutual advantage.

Summary.

A short survey is given of the theories and facts concerning the effect of the spleen on the blood picture, particularly of its hyperfunction, *i. e.* hypersplenism.

A case is described of lymphogranuloma benignum with splenomegaly and hypersplenism. Splenectomy was performed with a satisfactory effect on the blood picture.

A short survey is given of the indications and contra-indications for splenectomy.

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Reconstruction of the Oesophagus.

By

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At the annual meeting of the *Swedish Surgical Association* in 1941 the author demonstrated a skin-tube method for ante-thoracic reconstruction of the oesophagus (65). Covering of the new oesophagus on the anterior aspect of the chest with the aid of tube-pedicles constituted a technical innovation. Since the procedure has now been employed in four cases, a brief review of the results may be of interest; for a number of skin-tube reconstructions, almost analogous in type, have since been published and recommended, especially by American surgeons (10, 41, 42, 24, 32).

For the benefit of those who have not personally studied reconstruction of the oesophagus, a brief outline of the subject is given here. Since 1904, when WULLSTEIN (90) first published the idea of reconstructing the gullet (but never succeeded in realizing his method on living subjects), a great deal of work has been done to develop a practical technique. The object of these operations has been to replace the strictured or resected part of the oesophagus with a skin-tube, or with a raised part of the alimentary canal, or a combination of both.

Oesophago-dermato-gastrostomy, i. e. reconstruction by means of a skin-tube alone, was first tried by BIRCHER (4) in 1907. He made two parallel incisions along the chest wall and approximated the skin edges to form a tube, which was then covered by drawing together the skin from the sides. In both cases leakages and complications ensued which led to death. Subsequently, however,

skin-tubes alone have been successfully employed as substitutes for the oesophagus by PAYER (61) and others (71, 9, 77, 89, 34, 65, 91, 41, 82, 32). Each of these operators employed different forms of flaps, except ESSER (14), who constructed a skin-tube by using a Thiersch inlay graft subcutaneously on the chest wall. The tube contracted, however, and the result was unsatisfactory.

Where reconstruction has been effected by bringing up different parts of the alimentary canal, both the stomach and the jejunum and colon have been made use of — each of them with both isoperistaltic and antiperistaltic application.

Oesophago-jejuno-gastrostomy was successfully performed for the first time by HERZEN (25) in 1907, at Roux' (72) suggestion. Other surgeons too (28, 86, 63, 91) have employed this mode of operation in isolated instances. According to YUDIN (91), however, it is unnecessary to anastomose the caudal end of a raised jejunal loop with the ventriculus, since the passage of food direct to the intestine without passing the stomach does not seem to harm the patients, but on the contrary facilitates emptying.

Oesophago-jejuno-stomy with the stomach in Y-anastomosis had been performed antethoracically by YUDIN 21 times in his series of 88 complete reconstructions published in 1943. His work resulted in a technique worked out in detail (91, 92). RIENHOFF (67) reported, in 1946, three cases in which a similar procedure had been employed intrathoracically, and which required a shorter loop of intestine than that when the gut is brought up outside the chest.

Oesophago-gastrostomy with the stomach or a tubed part of the gastric wall raised to a high level has led, in most cases, to complications (35, 75, 53, 21) or failure. A few successful reconstructions have been noted, however (56, 49, 39, 80, 73).

Oesophago-colo-gastrostomy has succeeded in a few cases (52, 50, 70, 44) with the loop of intestine in an isoperistaltic direction. All the intestinal methods have also been combined with skin-tubes, either primarily when it has been found difficult to raise the gut sufficiently high to connect it with the cervical stump, or secondarily after a partial necrosis of the intestinal loop.

Among those methods which involve the primary insertion of a piece of skin-tube between the cervical stump and a raised loop of the jejunum, the one described by LEXER (44) has come to be by far the most common, under the designation

Oesophago-dermato-jejuno-gastrostomy. This relatively safe method

has led to good results in about 100 cases, published by roughly 30 different surgeons (44, 27, 33, 3, 81 and others). The relationship between length of skin-tube and length of intestinal loop has been conditioned by technical factors associated with the operation.

Oesophago-dermato-gastrostomy with the stomach raised to a high level has been carried out primarily by DENGEL (11) in one case, and as a secondary reconstruction in two cases after complications (37, 56).

Oesophago-dermato-colo-gastrostomy, similarly, has yielded good results only in rare cases (16, 38, 74).

An original method of transplanting a loop of jejunum embedded in a tube pedicle has recently succeeded for LONGMIRE and RAVITCH (48) in the reconstruction of three cases with corrosive strictures, the preliminary experimental work having been done by STAFFORD (48) on dogs.

Whether a skin-tube is employed alone or is inserted to form a lengthening piece, we still need a method of reconstruction that may be relied on to give us a functionally satisfactory tube, as well as covering of the same with good conditions for healing and without any major malformation of the patient's thorax. In this connection the author would suggest the following procedure:

Preparations for Reconstruction.

- A. *With tumours leading to resection of the thoracic oesophagus*, the cervical stump is exteriorized through the skin of the neck or at the jugulum, and the lower stump in the epigastrium through the diaphragm and left rectus muscle immediately to the left of the middle line (CRAFOORD). Fig. 1.
- B. *In corrosive stricture where dilatation is not expedient*. Fig. 2.
 1. Gastrostomy is performed immediately for nutrition of the patient before and during reconstruction.
 2. The upper end of the oesophagus is exteriorized after a division at the site of the stricture, if this latter is located high up, the lower stump then being buried in the tissue without further ado. Should the stricture be located lower down, the lower stump is closed and also exteriorized at the neck, where it seems to wither away like a blind pouch without any function. (9).
 3. As a preliminary to anastomosis of the skin-oesophagus with the rest of the alimentary canal, we might choose between:

- a. A direct communication with the stomach, in which, by an incision in the epigastrium, a part of the gastric wall is drawn out like a cone and opened to form a stoma. In the author's opinion, this gastrostomy should be performed as high up the body of the stomach as possible.
 - b. An indirect communication between the stomach and the exterior is established by means of an isolated jejunal loop, which is brought up to a corresponding stoma at a level largely determined by the possibility of mobilizing the intestine without endangering the circulation.
 - c. A direct communication between intestine and exterior is effected by raising a jejunal loop to the opening in the skin at an appropriate level. The stomach with the upper portion of the gut are then connected in Y-anastomosis according to YUDIN (91).
- C. *In congenital atresia of the oesophagus when direct anastomosis cannot be done, the stumps are exteriorized as stomata, or alternatively the operation is performed according to B 3 c above (LADD) (41).*

After malignant tumours the risk of metastasis indicates the postponement of reconstruction for about a year. At all events an interval of at least three months is allowed in order to obviate the risk of secondary contraction of the two stomata following their incorporation in the skin tube. In the meantime, if the patient so desires, a communication may be formed between the stomata by means of a rubber tube (GLUCK) the thickness of a finger which is fixed to the skin of the chest by adhesive tape. Liquid food can then be taken orally. Otherwise each of the two stomata may be kept dilated by a short piece of rubber tube of corresponding calibre. Prior to the reconstruction, moreover, the surgeon must satisfy himself that these tubes can be removed for one or more days without causing shrinkage. The skin of the thorax is carefully cleaned and coated with suitable ointment as a protection against leakages of saliva and gastric juice.

The Construction of the Skin-Tube is Subsequently Effected in Stages in the Following Manner.

1st stage. Preparation of an acromio-pectoral tube pedicle (t. p.) on the left shoulder. (Fig. 2 A₁.) Length 15—18 cm; breadth 7—8 cm. As a rule the skin edges under the t. p. can be closed primarily; otherwise a free skin graft is applied. Interval of one week.

2nd stage. Preparation of a thoraco-abdominal t. p. (Fig. 2 A₁.)

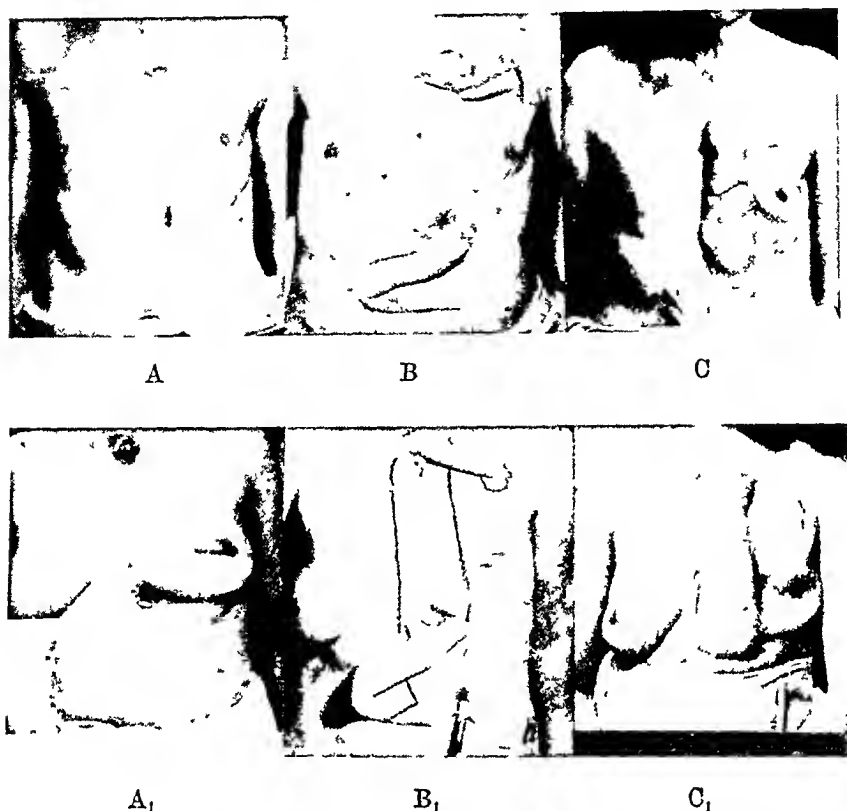


Fig. 1. Cases 1 and 2.

A and A₁ show the stomata of the oesophageal stumps which have been exteriorized through the skin. (Note that on A₁ the left breast has been amputated.) B. Situation after the fourth stage of the reconstruction. B₁. Situation after third stage of the reconstruction. Note the gastrostomy for nourishment. C and C₁. Final results.

Length 22—26 cm; breadth 8—10 cm. The skin edges under the t. p. can be closed by primary suturing. Interval of three weeks.

3rd stage. Freeing of the t. p. attachments located furthest from the stomata, and implantation of the same close to the openings. (Fig. 1 B₁; Fig. 2 B and B₁) Interval of four weeks.

4th stage. Undermining of a flap for the skin tube and outer attachments of the t. p's. In adult patients the distance between the vertical incisions through the skin of the thorax should be 6—7 cm at the upper stoma, and 7—8 cm at the lower. (Fig. 1 B.) Interval of one week.

5th stage. Construction of the skin-tube and covering it by spreading and suturing of the t. p's into the defect between the approximated edges of the wound. (Fig. 3.) Small triangular flaps of skin left basally on the underside of the t. p's exactly fill the gaps at each end of the skin-tube. (Figs. 3 and 4.)



Fig. 2. Cases 3 and 4.

A. shows the oesophagostomy in the jugulum and the jejuno-gastrostomy in the epigastrium, as well as the gastrostomy for nourishment. The skin flaps have been planned. A₁ shows the reconstruction after second stage. The oesophagostomy in the jugulum and the gastrostomy in the epigastrium are connected by a rubber tube. Both the gastrostomy for nourishment and the two tube-pedicles have been made. B—B₁. Situation after third stage of reconstruction. Note the two rubber tubes on B₁ for dilatation of the stomata. C and C₁. Final results.

The skin-tube is sutured with iodized catgut, the isolated sutures being applied intracutaneously so as to avoid penetrating into the lumen. In his first two cases the author formed the new oesophagus around a rubber tube connecting the stomata. From the upper end of the tube a silk thread was drawn out through the nose. With the help of this thread it was possible to remove the tube through the mouth after about a week. In the last two cases this tube was omitted without any disadvantage being noted. In point of fact, use of the tube entails a risk of broken sutures and the formation of fistulae in connection with the postoperative swelling. The skin is closed with silk round four drainage tubes with the diameter of a lead pencil.

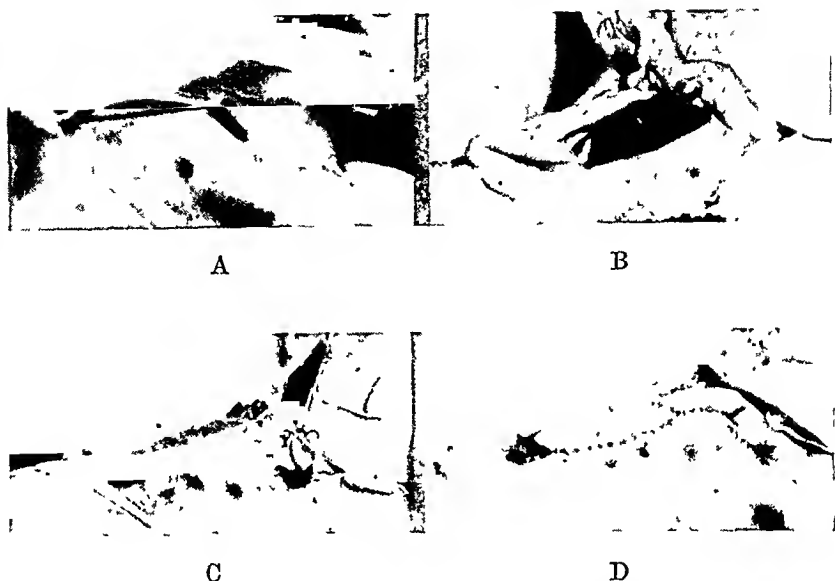


Fig. 3. *Fifth stage of reconstruction of the oesophagus according to the author's method.*

A. Rubber tube between the stomata (the tube is removed before commencing the operation). B. Skin-tube formed of flaps from the wall of the chest. Note the triangular defect at each end. C. Tube-pedicles opened preparatory to covering the skin-tube. The small triangular flaps of skin left at the base of the tube-pedicles are adapted exactly for covering the above-mentioned triangular defects in the skin-tube. D. The skin flaps from the tube-pedicles cover the new oesophagus and fill the defect in the skin of the thorax.

A gastrostomy for nutrition of the patient may be performed appositely between the third and fourth stages, if it does not already exist.

The patient is allowed to take liquid food through the new oesophagus after only one week, and progressively increasing quantities of solid food after two weeks. The gastrostomy is removed after two to three months, when possible fistulae have healed and the oesophagus is functioning well. The removal should be radical, the stomach wall being freed from the abdominal wall, since a persisting bridle might otherwise obstruct free movement of the stomach under special conditions (see Case 4).

The author presents below four cases in which the method of reconstruction described above has been employed with good results. In the first two cases (Fig. 1) the thoracic part of the oesophagus had previously been resected for cancer (CRAFOORD), one year having elapsed without any signs of metastasis. These two cases seem to be the first on record in which it has been possible to perform resections of the thoracic oesophagus for cancer and subsequent antethoracic reconstruction. The first

patient — a man — never fully recovered, however; he died from metastasis one year after the reconstruction. His new oesophagus functioned satisfactorily during the greater part of the interval. The other patient — a woman — lived for three years without discomfort and with her new oesophagus functioning admirably; until she too died from cancer after symptoms of secondary deposits for one year. A further two patients (Fig. 2)

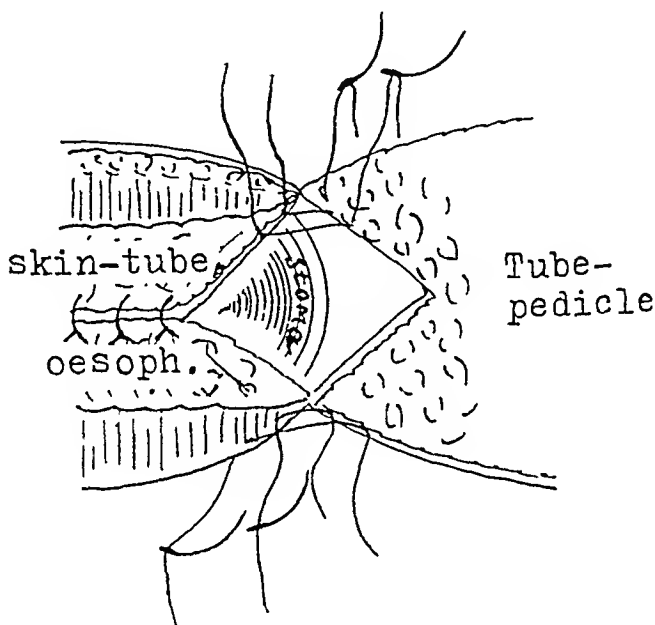


Fig. 4. Covering of the skin-tube by tube-pedicles. (The small triangular flaps of skin left basally on the underside of the tube-pedicles exactly fill the gaps at each end of the skin-tube.)

had been injured so severely by lye at the age of two that ever since they had been dependent entirely upon nutrition through gastrostomy. One of them — a 26-year-old woman — had been permanently hospitalized in her home district, being provided with suitable employment in the hospital. The surgeon-in-chief (J. WALDENSTRÖM) prepared the reconstruction by exteriorizing the cervical stump at the neck and performing a gastrostomy in the epigastrium by means of a short loop of jejunum. Since the reconstruction five years ago, the patient's skin-oesophagus has functioned exceptionally well. The patient has been able to lead a normal life, has been fully fit for work and has become a professional teacher. In the fourth patient — a young man of seventeen — the reconstruction was prepared by a direct gastrostomy with extension of the gastric wall to the skin in the epigastrium

(SÖDERLUND), and by the preparation (GRENABO) and widening (LIDSTRÖM) respectively of the oesophagostomy at the neck. In this youth too, the new oesophagus has functioned faultlessly; inter alia, the roentgen control, as in the previous cases, has revealed a good passage. An interesting observation was made when the patient returned after six months with symptoms in the form of smarting pains in the lower part of the skin-tube, to all appearances caused by regurgitation of acid gastric contents. Laboratory examinations revealed high acid values, and roentgen control a retention of the gastric contents. Since impaired emptying of the stomach was deemed to be causing his symptoms, an exploratory laparotomy was performed (SÖDERLUND), showing the neck of the stomach to be surrounded by adhesions, which were removed concurrently with the scar bridle from the previous nutritional gastrostomy. After the operation the patient found that the discomfort had disappeared, and roentgenograms revealed normal emptying.

The patient's symptoms in this case were possibly due to impaired motility of the neck of the stomach, caused in turn by stretching of the organ, when full, between the two gastrostomy sites. The obstruction served to force up the contents of the stomach into the lower part of the skin-tube, there giving rise to irritation.

Case Histories.

Case 1. 55-year-old man. (Fig. 1. A—C.) *Clinical diagnosis:* Cancer of the oesophagus, 31 cm from the upper teeth. *Operation* 3rd October, 1939 (CRAFOORD): *Transpleural resection of the thoracic oesophagus for cancer* + exteriorization of the cervical stump through the skin 5 cm below the jugulum, and of the lower oesophageal stump in the epigastrium through the diaphragm and the left rectus muscle 3 cm from the middle line. *Pathologic diagnosis:* Stratified epithelial cancer tending to very slight cornification. Discharged as healed after two months. Free interval of 13 months, during which the patient received his nourishment through a rubber tube between the stomata. Several alterations were made to the openings. Patient's weight increased.

Operation (RAGNELL): *Oesophago-dermato-gastrostomy.* Reconstruction in stages, 28th November, 1940—3rd April, 1941.

Patient ate a mixed diet through his new oesophagus as from 27th May, 1941, when he was discharged. After a fistulaplasty on 15th October, 1941, he was fully healed, and roentgen control showed rapid and unobstructed passage of the contrast medium. After living at home, there was a recurrence of fistulae, which alternately healed

spontaneously or after plastic operations and then reopened, until the patient ultimately died in his home on 3rd August, 1942. Regarding the cause of death, Dr. V. MONTELL reports: "The patient's general condition rapidly deteriorated after the last fistulaplasties. He suffered discomfort from abdominal pains and diarrhoea, and a tumour in the abdomen was interpreted as a secondary deposit, possibly located in the liver. Towards the end, the patient's oesophagus functioned quite satisfactorily and the fistulae were practically healed."

Case 2. 47-year-old woman. (Fig. 1. A₁—C₁.) *Clinical diagnosis:* Cancer of the oesophagus, 27 cm from the upper teeth. *Operation* 27th August, 1940 (CRAFOORD): *Transpleural resection of the thoracic oesophagus for cancer* + exteriorization of the cervical stump through the skin a few centimetres below the jugulum, and of the lower oesophageal stump in the epigastrium through the diaphragm and the left rectus muscle 3 cm from the middle line. *Pathologic diagnosis:* Stratified epithelial cancer tending to slight cornification. Discharged as healed after 1½ months. Free interval of 13 months, during which the patient received her nourishment through a tube between the stomata. The latter were widened on 18th May, 1941.

Operation (GIERTZ): Amputation of the left breast for retention cyst.

Operation (RAGNELL): *Oesophago-dermato-gastrostomy.* Reconstruction in stages, 12th September, 1941—9th December, 1941. The patient ate a mixed diet through her new oesophagus as from the date of her discharge, 17th January, 1942. A small fistula persisted but healed soon after fistulaplasty, according to a report by the patient from her home. According to regular reports, the patient was quite symptom-free and fully fit for work. Roentgenograms showed unobstructed passage of the contrast medium. In January, 1945 there was incipient discomfort from stenosis symptoms in the oesophagus and pains localized to the lower stoma. During the ensuing six months, clinical and roentgen examinations showed stenosis symptoms with retention of air and contrast medium in the skin-tube, the patient also finding it difficult to ingest food.

Operation 18th June, 1945 (RAGNELL): Exploration of the skin-tube and specimen taken from its wall. Coral-like granulation bundles were found which, on histopathological examination, showed incipient canceroid. The patient's general condition rapidly deteriorated. On 7th August, 1945 a jejunostomy was made (GRENABO), after which there was a temporary improvement. On 23rd October the patient was discharged at her own request to return home, from where it was later reported that she was no longer able to take any food through the oesophagus. Her condition steadily deteriorated and she died at home on 31st August, 1946. According to Dr. S. PALM, the cause of death was secondary deposits of the cancer.

Case 3. 26-year-old woman. (Fig. 2 A—C.) *Clinical diagnosis:* Corrosive stricture of the oesophagus. Lye burns in 1918 at the age of two. In 1919 the patient was unable to swallow even saliva, so

that a gastrostomy was performed through which she had since received her nourishment. *Operation* 31st March, 1942 (J. WALDENSTRÖM): *Jejuno-gastrostomy* with exteriorization of the jejunal loop through the abdominal wall in the epigastrium, and of the oesophagus at the neck.

Operation 10th July, 1942 (RAGNELL): *Oesophago-dermato-jejuno-gastrostomy*. Reconstruction in stages 10th July, 1942—15th December, 1942. 19th January and 19th February, 1943, fistulaplasties, after which the new oesophagus functioned well. On 26th October, 1943 roentgen control revealed rapid passage of contrast medium. The gastrostomy was removed. On 28th August, 1948 the patient reports that she is fully fit for work as a professional teacher. The oesophagus has functioned faultlessly. She is able to eat all kinds of food. Because the pharynx, though not the gullet, feels constricted, she chews certain food, such as meat, somewhat longer than usual. On eating heavily spiced food some irritation is occasionally noticed in the skin-tube, but subsides after she has drunk water. She declares herself to be exceedingly satisfied with her new gullet, which has given her a new lease of life.

Case 4. 17-year-old youth. (Fig. 2 A₁—C₁.) *Clinical diagnosis:* *Corrosive stricture of the oesophagus.* Lye injury in 1930 at the age of two. Fed through gastrostomy since 1933. Clinical and roentgen examinations show pronounced stricture of the whole of the oesophagus. Able to swallow liquid food, but receives his nourishment through the gastrostomy. *Operation* 3rd July, 1946 (SÖDERLUND): Preparation of a further gastrostomy. *Operations* 1st and 8th August, 1946 (GRENABO): Exteriorization of oesophagus at the neck in two stages. In the first stage the side of the gullet was sutured to the wound; in the second stage it was opened. *Operation* 17th April, 1947 (LIDSTRÖM): Widening of the oesophagostomy. Thereafter, both stomata functioned well.

Operation 7th October, 1946 (RAGNELL): *Oesophago-dermato-gastrostomy*. Reconstruction in stages 7th October, 1946—7th November, 1946, and 3rd November, 1947—10th January, 1948. 29th December, 1947: Patient eating semi-solid food without difficulty. Smarting pains in lower part of skin-tube in connection with meals. 10th January, 1948: Discomfort mitigated after administration of Antacid tablets. Discharged. The gastrostomy to be removed in a few weeks time at patient's local hospital.

31st August, 1948. Re-admitted for control. Eats all kinds of food without difficulty. Severe discomfort from smarting pains in lower part of skin-tube, both at and between meals. *Roentgenography* of the stomach reveals a certain difficulty in emptying, which does not seem to be due to organic obstruction. 6th September, 1948: Examination of gastric contents shows elevated acid values (45—83). 25th October, 1948: Re-admitted for operation.

Operation 1st November, 1948 (SÖDERLUND): *Exploratory laparotomy and gastrotomy*. The adhesions round the neck of the stomach were

detached, and the scar bridges persisting after the nutritional gastrotomy extirpated. Gastrotomy made possible palpation of the dermatogastrostomy, which readily admitted a finger, and the pylorus, which felt normal. The abdomen was closed without further measures.

Roentgenography of the stomach, 24th November, 1948, revealed normal emptying.

Patient discharged on 4th December, 1948 after post-operative recovery without complications. His discomfort subsided almost completely after the operation, disappearing entirely on renewed medication with Antacidæ tablets.

Discussion.

The method of reconstructing the oesophagus in cases of corrosive stricture by means of a jejunal loop alone, brought up antethoracically (YUDIN) (91) or intrathoracically (RIENHOFF) (67) — *oesophago-jejunostomy* or *oesophago-jejuno-gastrostomy* — has of recent years occasioned well-merited interest owing to its rapidity. In Sweden, CRAFOORD has performed one successful operation according to YUDIN. Oesophagoplasty of this type, however, calls for a very careful selection of cases (YUDIN) and still involves a by no means inconsiderable risk to the patient. In many cases the surgeon hesitates to employ the method owing to the risk of unexpected complications in the form of an excessively short or fat mesenterium or adhesions in the abdomen, which render difficult or impossible the mobilization of the intestinal loop, as well as circulatory disturbances after such interference, especially in elderly patients (90). Hence a good skin-tube method, whether it be applied in the form of *oesophago-dermato-gastrostomy* (cases of all types) or *oesophago-dermato-jejuno-gastrostomy* or *oesophago-dermato-jejunostomy* (stricture cases) can still hold its own vis à vis the purely intestinal method. Reconstruction by means of a skin-tube alone entails, in the hands of a surgeon experienced in such work, no vital risk to the patient. In the author's opinion, therefore, the surgeon should make clear these circumstances to the patient before undertaking any reconstruction, and leave the patient free to choose for himself. At the same time it should be pointed out that all the methods named above provide a permanent and functionally perfect oesophagus, which makes it possible for the patient to lead a perfectly normal existence. That the skin-tube too will function faultlessly provided only the lumen and stomata are made sufficiently wide

at operation, has been proved to the full both clinically (17, 9, 47, 58) and fluoroseopically (11, 47, 22, 65). Peristaltic movements within the tube itself are not necessary for the passage of food, this being best demonstrated by the fact that a rubber tube or even a piece of intestine introduced antiperistaltically (23, 74, 73), can be substituted for the oesophagus. The cause is considered to lie in the powerful squirting effect released by the act of swallowing in the pharynx. As regards permanence, Nature in these cases seems to be endowed with a remarkable power of adaptation, manifested in metaplasia of the skin of the tube, in which the hairs and the sebaceous glands disappear almost entirely, the horny layer is reduced and the surface instead becomes smooth, mucous and slippery (55, 93, 3).

The methods earlier employed for covering the skin-tube by various types of direct transfers of flaps from the sides, often involved, because of tautening, a considerable risk of incurable fistulae formation and major malformation of the skin of the chest. In this respect the author's method, reported above, of covering the skin-tube probably constitutes a technical advance in the direction of increased security, especially in those cases where insufficient skin is available in the region of the skin-tube. This applies in particular to small children with skin that does not lend itself to transfer in the reconstruction of certain types of congenital atresia of the oesophagus (41, 42); to elderly patients with unelastic skin (Case 1), or cases in which scars from previous operations set a limit on the amount of skin available (Case 2); and to women as a whole, because of the need to avoid dislocation of the mammae.

Summary.

At the annual meeting of the *Swedish Surgical Association* in 1941, the author demonstrated a new technique for covering the antethoracic skin-tube with the aid of tube-pedicles in reconstruction of the oesophagus. Since similar methods for *oesophago-dermato-gastrostomy* have subsequently been published and recommended by other quarters, the technical experience gained from four completed oesophagoplasties in which the author's method was employed, together with the results achieved, are reported. In two of these cases the thoracic oesophagus had previ-

ously been resected for cancer by another surgeon. These seem to be the first recorded combinations of wide resection for malignant tumour and subsequent antethoracic reconstruction. The other two cases concerned corrosive strictures of long standing. A short resumé of past and present methods of reconstruction is given for purposes of guidance before the technical details of the author's method are presented. The paper concludes with a discussion on the advantages and usefulness of the different methods under varying anatomical premises. The durability and satisfactory functioning of the skin-tube are emphasized and demonstrated by histological, clinical and roentgenological observations. The author expresses the opinion that every patient, confronted with the possibility of reconstruction of the oesophagus, should be informed of the advantages and disadvantages of the various methods, both in respect to the hazards and the time factor, and should as far as possible be left free to decide for himself.

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Postoperative Emptying Difficulties in Direct Connection with Gastric Resection.

By

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The often serious complications involved by postoperative emptying difficulties or gastric ileus as a sequel to gastric resection are naturally attracting much attention in surgical quarters. Severe cases that have occasioned re-operation, some of them with a fatal issue, have been reported from Sweden by different authors (PERMAN, BRANDBERG, SANDBERG etc.). Without entering into particulars here regarding the operation technique, it may be pointed out that great variations occur with respect to the extent of the resection and other technical details.

In this paper the author presents (partly in tabular form) a certain number of cases of ulcer, examined with respect to emptying difficulties as a direct sequel to an operation. All these cases have been operated by the author personally with the technique proposed by his former teacher, GUSTAF SÖDERLUND, a brief account of which will now be given: High resection according to Billroth II with the oral resection edge one to two cm. up on the vessel-free space on the major side across to the minor side, retrocolic gastroenterostomy on the short loop, a relatively small gastroenterostomy comprising one-third, or at most one-half, of the gastric resection opening, suturing with single catgut sutures in two layers. The remainder of the stomach has been emptied by suction from possible contents. Preoperative medication: morphine-scopolamine, anesthesia: spinal (if necessary, narcotal-

laughing gas). Pre- and postoperative control of the fluid balance and, if required, an adequate fluid therapy. Introduction of the stomach tube on the least suspicion of emptying difficulties.

As shown by the above table, no detectable postoperative emptying difficulties whatever occurred in the great majority (44) of the cases. Out of the 8 cases where gastric retention had occurred, 2 were found to have been due to insufficient suturing in the duodenal stump and may therefore be passed over in this connection. In none of the remaining 6 cases can the emptying disturbances be characterized as severe (duodenal tube for 1 to at most 5 days). Re-operation because of emptying difficulties was not found necessary in a single case.

Though the series of gastric resections presented here is rather small, it may be regarded as a supplement to OLOVSON's report (1945) regarding the frequency and degree of postoperative emptying difficulties as a sequel to the Billroth II resections performed at Serafimerlasarettet in the course of the years 1938—1945. Out of the 344 cases reported there, 77 had required a duodenal tube merely for a relatively short time, no severe emptying difficulties had occurred, nor were there any re-operations.

As causes of the postoperative emptying difficulties after gastric resection, the following have been indicated in the literature: Inflammatory swelling proceeding from the anastomosis suture and impaired gastric motility (PERMAN and others), morbid changes in the mesocolon in the form of excessive fat content, abnormal shortness and fibrosis (BRANDBERG) and, especially American quarters, hypoproteinemia with edema and resulting swelling at the anastomosis, besides impaired motility of the stomach and intestine.

Hypoproteinemia as a common, or dominant, factor in postoperative emptying difficulties is considered by other investigators, on the other hand, to be a less probable explanation of those difficulties (ERSKIND and others). In some cases which, because of severe postoperative emptying difficulties, had been submitted for re-operation, more or less marked mechanical causes in the form of narrowing of the stoma, adhesences and sharp bends on the jejunum had indubitably occurred; in other cases again, the explanations seem to be merely hypothetical.

In this connection it should be noted that gastric ileus may occur *e. g.* after cholecystectomy, where neither the stomach nor the intestine had been subjected to surgical operation. The dom-

inant feature in postoperative gastric ileus is, of course, the presence of large amounts of fluid retained in the stomach. This has been pointed out by WAHREN, who considers that a circulatory insufficiency in the splanchnic region, secondary to the operation, with consequently diminished resorption, may conceivably be the true explanation. This theory, which, in my opinion, is well-grounded, has been applied by WAHREN in practice, by passing from relatively small gastric resection (postoperatively followed, in a couple of cases, by serious states of ileus) to high resections of the Billroth II type, without any sequels in the nature of emptying difficulties.

Besides the surgeons previously mentioned (SÖDERLUND and WAHREN), RICHTER, amongst others, performs high resections with similar favourable experiences in regard to postoperative emptying difficulties.

As regards the operation technique adopted by SÖDERLUND, there is a detail which should be stressed in this connection: The relatively narrow G. E.-stoma is sewed with single sutures, which probably affords greater facilities for expansion and extension than a continuous suture (previously pointed out by OLOVSON). That this is actually the case seems to be borne out by an experimental investigation recently made by RÖDÉN (the report on which is now in the press).

Summing up, it may be stated that the operative technique elaborated by SÖDERLUND (a modification of the Billroth II resection procedure) obviates the development of any appreciable postoperative emptying difficulties, and that, as the results in regard to the occurrence of relapses and other postoperative troubles must be regarded as very encouraging (according to a follow-up examination made by OLOVSON in 1945), this method may be considered to be highly satisfactory.

Summary.

Communication regarding 52 Billroth II resections for ulcer, examined with special regard to emptying difficulties as direct sequels of the operation. In 44 cases no detectable emptying difficulties whatsoever occurred, in 6 cases a gastric retention which required the use of a duodenal tube for 1 to at most 5 days (2 cases with insufficient suturing of the duodenal stump and resulting in retention are passed over in this connection).

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Carcinoids of the Small Intestine and the Stomach.

By

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Carcinoids of the appendix are not entirely uncommon; FORBES (1925) reports an occurrence of 0.4 per cent in all operatively removed appendices. In the Scandinavian literature PERMIN and STARKLINT have collected a number of cases, and VON BAHR describes a case with a peculiar course, namely perforation to the urinary bladder.

In the rest of the intestinal canal they must be considered uncommon and the majority of cases reported are chance autopsy findings.

At Vadstena hospital the author has during recent years operated on a patient with a carcinoid of the ileum causing stenosis, and also on a case of carcinoid of the stomach giving rise to pain and hemorrhage.

Case 1. A woman aged 72 years was in 1947 admitted with the clinical picture of ileus of the small intestine. She was immediately operated on by the author. Entero-anastomosis. Laparotomy below umbilicus. A conglomeration of reddened and distended small intestine bulged forth. As origin to the obstruction, a quite small, stricturing tumor was found in the distal segment of ileum. In consideration of the acute ileus condition, an entero-anastomosis was done in this séance. The postoperative course was smooth.

The patient returned one month later and after preoperative treatment a new operation was carried out. *Operation* (the author): Resectio intestini tenuis. Approximately 60 cm. of small intestine with the stenosing tumor was resected, after which an end-to-end anastomosis was performed. Blood transfusion and intravenous drip were given. The postoperative course was uncomplicated.

Pathological-anatomical examination (SANTESSON): "Close to the anastomosis there is a shallow tumor in the bowel wall, about one-

half the size of a bean. On section, the tumor tissue is pale yellowish, and has a rather necrotic appearance, but may conceivably be a carcinoid. *Microscopic Examination*: The small tumor is a carcinoid. Cellular structures of rather homogeneous appearance in areas of the mucosa but mainly in the submucosa and interstitially in muscularis. In areas the infiltration reaches the fibrously thickened subserosa. No lymph glands are demonstrable. The cell pictures are, as mentioned above, rather homogeneous, but occasional remarkably large and hyperchromatic nuclei are observed. There is a very occasional mitosis. These conditions and the wide infiltration of the tumor tissue in muscularis and also in the subserosa give rise to a suspicion of malignancy. There is, however, no substantiation for carcinoma. *Pathological-anatomical diagnosis*: Carcinoid with picture giving rise to suspicion of malignancy."

The patient was recently seen at *follow-up examination*. Her general condition was good and she had no discomfort from the intestinal canal. Roentgen-examination with contrast meal (MOBERG): Nothing pathological.

Case 2. A woman of 68 was in 1948 admitted to the medical department for severe pain in the pit of the stomach of some days standing, dark stools, and hematemesis.

X-ray examination (MOBERG): Rather high up in corpus, two fingers breadth below cardia, a contrast defect the size of a ping-pong ball and rounded in shape was found, and above this a defect about the size of a cherry. The changes were distinctly defined and were probably benign tumor masses. The relief of the mucosa was normal. There was no difficulty in evacuation. Bulbus duodeni showed no changes. The *roentgen examination* had thus revealed two rounded, and probably benign, tumor growths in corpus (Fig. 1).

Operation (the author): Percain anesthesia. Laparotomy + gastrotomy + excision of polypi with diathermy + electric cautery of polyp anlage. Median incision above umbilicus. The polypi were easily palpated in the upper portion of the stomach. The stomach was incised vertically with diathermy. The pedunculated polypi, which had involved healthy mucosa, as far as could be judged, were excised at the base with diathermy, after which the wound in the mucosa was sutured. The mucous membrane of the stomach showed a number of nodules of various sizes, evidently the buds of new polypi. A rather large polypus was cauterized, but as regards the others, it hardly seemed worth while to take any measures. The stomach was closed by a double row of stitches. The abdomen was sutured.

The postoperative course was uncomplicated, the patient was discharged healthy. She was recently seen at follow-up examination, at which the roentgenogram showed absence of pathology from the stomach.

Pathological-anatomical examination (SANTESSON): "One approximately walnut-sized and one barely hazelnut-sized polypus solid growth. *Microscopic examination*: Both polypi are of a largely similar structure. The surface is covered with a thin mucous membrane with glands of pyloric type. They are made up of solid epithelium with closely ar-

ranged pseudostratified, columnar, or rounded, solid alveolar complexes. The cells of these are regular, homogeneous, medium sized, rounded or polyhedral, with rather abundant finely granular, light colored cytoplasm and light cystiform nuclei, with coarsely granular chromatin and distinct nucleoli. No mitotic cells are observed (in the epithelium of the smaller polyp the cells are somewhat smaller and darker). The epithelial tissue mainly involves and destructs the submucosa and muscularis, of which only small remnants are found between the tumor complexes. The epithelial tissue shows in several areas a destructive infiltration of muscularis mucosae, with distribution also in the deeper layers of the covering mucosa, where it in several areas appears to be in direct contact with the deep-seated portions of the glands. In two areas the tumor involvement reaches nearly to the surface, which, in the case of the smaller polyp, is ulcerated in some places. The general circumscription downwards and to the sides is, on the whole, fairly smoothly rounded.

There is evidently a question here of a type of epithelioma very uncommon in the stomach, and, judging from the circumstances, derived from a basis of malformation. The structures, as stressed earlier, are in essential respects most nearly correspondent to carcinoids. On comparison with the cells of preparations of appendiceal carcinoids, the epithelial cells seem to be rather larger, however. They have a definite similarity to the cells of the Langerhans islets of the pancreas. Some authors consider that the carcinoids may derive from aberrant cellular islets of Langerhans (this mainly propounded by SALTYKOW). Such pancreas anlage are not so uncommon in the stomach wall, while on the other hand, judging by the literature, carcinoid tumors may occur, but are extremely rare, in this site.

Judging from the structures, there is in the present case evidently a question of either true carcinoids or very closely related growths (possibly derived from aberrant pancreas anlage).

With regard to malignancy, the tumors may be considered to behave as carcinoids, which commonly are locally malignant only, in but rare cases showing true malignancy with metastases. As pointed out above, the epitheliomas are, judging by the findings of the sections, totally extirpated.

Pathological-anatomical diagnosis: Two polypi with a mucous membrane of pyloric type and built up of epithelium with structures most nearly correspondent to those of carcinoids."

Carcinoids in the ileum are not entirely uncommon. DOCKERTY and ASHBURN, in reviewing the pathological-anatomical material of the Mayo Clinic from the period 1906 to 1943, found 30 cases of carcinoid of the ileum, 13 with metastases. BATSFORD and SEIBEL, in similar studies of the material of the Peter Bent Brigham Hospital from 1913 to 1946, found 16 carcinoids of the ileum, of which 15 were random autopsy findings.

Carcinoid of the stomach is mentioned by ASHWORTH and

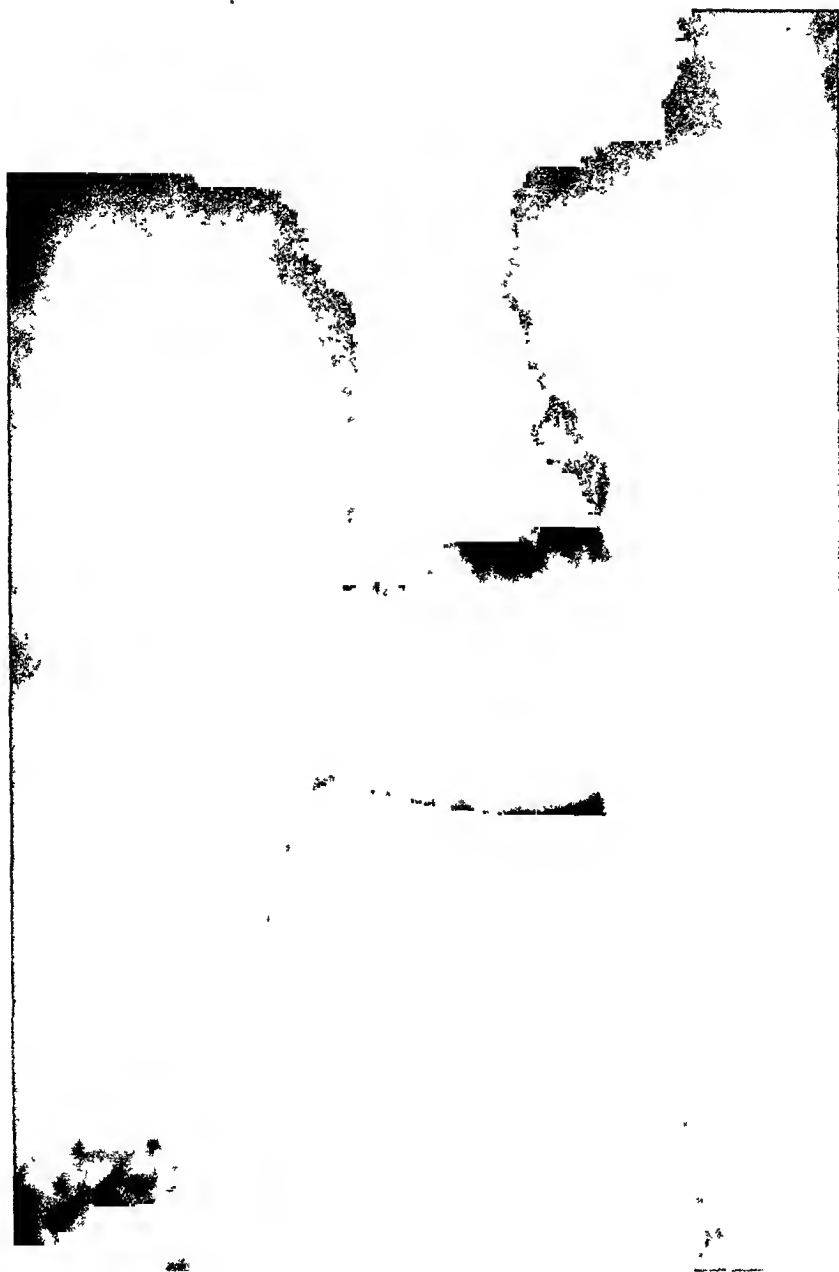


Fig. 1. Case 2. Roentgenogram showing carcinoid polyp in stomach.

WALLACE, 1941, 6 cases having been published up to that time; 3 of them, chance findings. Carcinoid may also, rarely, occur in the gall bladder, in diverticuli, in colon and primarily in the mesentery.

Regarding the etiology of these tumors various opinions have been put forth. TRAPPE, TOENNISSEN and SALTYSKOW consider them to derive from aberrant pancreas anlage, while LUBARSCH was the first to consider them to derive from the cells in the bottom of Lieberkühns crypts in the mucosa of the intestine. MASSON and others have confirmed this derivation of the carcinoids from the so-called Nicolas-Kultchitzky-Schmidt cells in the bottom of Lieberkühns crypts. These cells contain chromaffin and argentaffin granules. Therefore, today carcinoids are often designated argentaffinomas.

The tumors are frequently multiple. They are yellow in color and were long considered to be entirely benign. This, however, is fallacious, as they may give rise to stenosis and metastases. However, even after metastasis, they appear to be relatively benign. Cases have been reported in which resection of the primary intestinal tumor was carried out and metastases observed, but when the patient, several years later, came to autopsy for other causes, the metastases were found stationary. Such a case is mentioned by MALLORY, the metastases after 16 years having been found entirely unchanged, and without having caused the patient discomfort.

TERPLAN, WEINTRAUB and WOLF describe a case in which the patient was operated on 5 years previously with ileocolostomy only, because of metastases of the liver; the patient died from drowning and autopsy revealed that there was no growth of the liver metastases.

STEWART and TAYLOR describe a similar case with the patient alive after 10 years in spite of a large metastasis in the pelvis.

CAMERON has established that not less than 33 per cent of the patients were living 8 years after operation for metastatic carcinoid.

It is thus of practical importance for the surgeon to be able to establish whether there is a question of a carcinoid. Bowel resection should be carried out even if there are metastases. In view of the rarity of the tumors, however, the surgeon will, at best, see an intestinal carcinoid only once or twice during his career. In the present case there was nothing that suggested this possibility to the operator; no particular yellowish color of the

growth was observed, nor, as described by certain authors, any conspicuous hypertrophy of the smooth muscle, not caused by stenosis. This hypertrophy of the smooth muscle in the case of a very small tumor has, *du reste*, been suggested as a possibility of making the roentgenological preoperative diagnosis of carcinoid. MILLER and HERMAN have in one case considered themselves able to make this diagnosis on the finding of "acute buckling or kinking of the bowel in cases in which carcinoid tumors have infiltrated the serosa".

It is, furthermore, of importance to recognize that carcinoids not uncommonly are primarily multiple, wherefore the intestine should be examined carefully for the possibility of further tumors. In the stomach this goes without saying, and in the present case of carcinoid of the stomach there is clearly a possibility of further carcinoids than the two extirpated.

In this commentary to the cases the author has mainly taken into consideration the points of importance for the surgeon. Notwithstanding the rare occurrence of the tumors, there is a copious literature on the subject, especially from the pathological point of view. The reader is referred to the bibliography.

Summary.

The author reports 2 cases of uncommon localizations of carcinoid tumors, one of which was sited in the ileum, the other in the stomach.

In this connection, an account is given of cases of carcinoid in the literature and also of the theories relevant to the derivation of these tumors. The relative benignancy of the growths is mentioned, which should lead to the removal of the primary tumor even in the presence of established metastases. Experience shows that the metastases may remain virtually stationary even after the interval of several years.

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The Surgical Treatment of Duodenal and Gastric Ulcers in Very Young Persons.

By

THORE OLOVSON.

Ulcers occur in all ages from the youngest to the oldest, predominating in the third and fourth decades. In the first year of life ulcers are very rare; though cases have been reported, even of perforating ulcers, in infants. A collocation, recently made in America, of all cases of ulcer up to the age of fifteen reported in the literature comprises 245 cases (BIRD, LEMPER, MAYER 1941). Roughly one half of these consisted of cases of perforated and stenosing ulcers, operated upon. The real number of cases is of course considerably higher.

The incidence rises, however, with increasing age. In persons in late childhood and early youth, *i. e.* between the ages of 15 and 20, ulcers can no longer be considered particularly uncommon. In a medical series of 1,116 ulcer cases, BRUUSGAARD (1946) stated the incidence to be 5 per cent in persons between the ages of ten and nineteen. If we include those cases which have healed without diagnosis and those which have only been diagnosed and treated after attaining the age of 20, this figure will be increased still further.

Without going into a detailed discussion of the patho-anatomical and clinical aspects of ulcers in children and young people, the author would point out that a considerable degree of uniformity is found in adult patients. The ulcers have the same general appearance and localisation. Duodenal ulcers preponderate. The disease itself is far more common in males than in females. Periduodenitis and perigastritis occur; likewise indurations, scars and



Fig. 1. Roentgenogram from Case 3, sixteen years after resection.



Fig. 2. Roentgenogram from Case 4, eleven years after resection.

stenosis. As regards the clinical picture there is a marked tendency to perforations and severe haemorrhages.

From the surgical point of view, ulcers in children are of minor importance; it is largely perforations and stenosis that are subjected to surgical interference. In this connection the methods employed usually consist in suturation and gastroenterostomy, resections being rare. Greater surgical importance attaches to ulcers during adolescence, *i. e.* in patients between the ages of 15 and 20, the age group which forms the transition from childhood to adulthood. As regards the treatment of ulcers in this age group, an extremely conservative view is held by surgeons and above all by interns, diverging from the general attitude to the treatment of ulcers in adults. Indeed the age of 20 is given as a limit, below which adequate resection is warranted only by exceptionally compelling circumstances. The reason why these ages are regarded in a special light and why a conservative attitude is common seems to be assignable primarily to the age as such. There is a perfectly logical disinclination to operate upon an organ in the process of development. Moreover, emphasis has been laid on the major immediate hazards which operation involves, as well as the tendency to post-operative complications, anaemia and poorer late results.

By way of illustration, the author describes here a series of cases from the age group in question, *i. e.* from 15 to 19 years, on which resections were performed.

Case 1. Male student, aged 15. Previously quite healthy. At age of 13 patient commenced to experience abdominal pains soon after meals. Pains and hunger pain in stomach also at night; frequently obliged to eat something during the night to alleviate the discomfort. Consulted physician, received medicine (antacid) and dieted; was better for a time but symptoms soon reappeared and have been very severe of late. Observed recently that faeces were black. *Status:* General condition fairly good. Heart and lungs 0. *X-ray examination:* grossly deformed bulb with deep indentations; one niche somewhat larger than a pea 1 cm distal to the pylorus. Stomach without remark. Normal emptying time. *Test meal:* *Retention:* 25 gm, mucus very slight; no residue of lingonberry jam; dimethyl 50, phenolphthalein 53. *Test breakfast:* 150 gm, rather well digested; dimethyl 41, phenolphthalein 72.

Operation (1934): Resection of stomach and duodenum according to Billroth II + gastric fistula according to Witzel. On anterior wall of duodenum, 1 cm distal to pylorus, a niche somewhat larger than a fingertip. Invagination of duodenal stump without difficulty. Resection of stomach to point immediately above angular notch. *Pathologic diagnosis:* Chronic ulcer with no sign of malignancy. Healing without complications. Discharged after 16 days.

At follow-up 14 years after operation, patient furnished the following data: Has been army officer (Lieutenant) for eight years; considers himself *quite healthy* in respect to stomach; eats all kinds of food without slightest discomfort; eats same number of meals and same amount as normal person. States that during first few years after operation he found some difficulty in drinking milk; this caused attacks of nausea which subsided after short rest. Otherwise has been able to digest all kinds of food the whole time.

X-ray examination (1948) shows moderately large gastric stump, abundant mucous membrane folds, no niche perceptible. Rather slow emptying; some contrast medium remains after one hour; no contrast medium in the stomach after three hours.

Case 2. Seaman, aged 16. Always in good health previously. About six months ago, at age of 15, incipient symptoms from stomach in form of regurgitation of sour gastric contents and nausea after meals; slight vomiting occasionally but no pains. A few days before hospitalization patient experienced sudden acute gastric haemorrhage and was admitted to Serafimerlasarettet in a very weak condition. *Blood status:* Hb. 33%; red bl. corp. 1.8 million, white bl. corp. 8,600. Faeces: Weber ++++. Patient was first admitted to medical department and received blood transfusion (400 cc blood), being transferred one day later to surgical department. *X-ray examination* on the third day after admission showed normal stomach; in duodenal bulb a constant deformation with large indentations on greater and lesser curvature sides. Mucous membrane folds radiating towards a pea-sized niche 1 cm distal to pylorus. *Test meal* (seven days after admission): No retention. *Test breakfast:* 100 ml retrieved rather well digested; HCl 35 and total acidity 66. *Operation* (1941) 10 days after admission: Resection of stomach and duodenum according to Billroth II. On anterior wall of bulb a small ulcer with scarry indentations in the wall. Further ulcer found directly opposite on posterior wall of duodenal bulb. Typical resection. *Pathologic diagnosis:* Duodenal ulcer with no sign of malign degeneration. — Healing without complications. Rapid improvement in general condition, patient being discharged after 21 days.

At follow up 7 years after operation, patient stated that he considers himself fully recovered; has no symptoms in digestive canal, does not diet and eats full meals; feels perfectly healthy and has increased about 10 kilos in weight.

Case 3. Male clerk, aged 16. Since age of 12 suffered from abdominal pains and vomiting after meals. Vomiting at times very severe and has come after all kinds of food; sometimes has vomited up to four times a day. Attacks of vomiting preceded by pains in lower abdomen, not radiating; sometimes pains at night which have been alleviated by meal. Symptoms have occurred periodically with symptom-free intervals of some months. During last few days before admission, noticed that faeces were black. Admitted to Serafimerlasarettet with acute gastric haemorrhage. *Status:* General condition affected, very pale. *Blood status:* Hb. 70 %;

red bl. corp. 4.3 million, white bl. corp. 8,200. Sedimentation rate 6 mm; Wassermann reaction negative. *Test meal*: No retention; dimethyl 44, phenolphthalein 60. *Test breakfast*: 180 ml well digested; dimethyl 70, phenolphthalein 100. *X-ray examination* shows stomach of normal size. Massive turgid mucous membrane folds. In pyloric canal, deep and powerful peristaltic waves are seen pumping out small quantities of gastric contents into duodenum. Distal end of pyloric canal together with pylorus and bulb deformed like an irregularly shaped tube with deep indentations both from greater and lesser curvature sides; and on several roentgenograms an irregular bean-sized darker spot is perceptible. Substantial residue after four hours. Repeated Weber tests positive. — During first few days patient had repeated vomitings of dark brown gastric contents; received several blood transfusions. *Operation* (1932) after six weeks: Resection of stomach and duodenum according to Billroth II + gastric fistula according to Witzel. In the bulb on the lesser curvature side, a walnut-sized ulcerous tumour was palpated. Duodenum mobilized from pancreas; in posterior wall of duodenum was observed a pea-sized ulcer; no sign of penetration to pancreas. Healing without complications. *X-ray examination* of stomach three weeks after operation showed a small stomach with comparatively normal emptying time. Patient discharged completely free of symptoms. *At follow-up 16 years after operation*, patient states that he considers himself fully recovered. Never experiences pains or vomiting. Does not diet, eats all kinds of food, though is not altogether well after oatmeal porridge and gruel. Eats same number of meals and same amount of food as normal person. *Blood status*: Hb. 100 %; red bl. corp. 5.1 million. *X-ray examination* (1948): The persisting stomach is about the size of an orange. No pathologic changes perceptible either in the stomach, the stoma or the connecting loop. Emptying of the stomach takes place at the rate which is normal for this type of operation. After two hours only an inappreciable quantity of contrast medium remains in stomach; after three hours the stomach is quite empty. (Fig. 1.)

Case 4. Unskilled labourer, aged 17. At age of 15 patient had incipient symptoms from stomach in the form of hunger pain and gnawing sensation, which subsided on eating. About a year ago, acute gastric haemorrhage with vomiting of blood and tarry stools. Admitted to medical department of Serafimerlasarettet. Minimum Hb. was 30 %. *X-ray examination* of stomach negative. Treated with blood transfusions. Symptoms disappeared for about six months, after which further haemorrhage occurred. Readmitted to medical department. Hb. was then 32 %. *X-ray examination* of stomach revealed no niche, but mucous membrane fold in duodenal bulb was seen to radiate towards a specific point. Symptoms reappeared after some time, wherefore patient was admitted to surgical department.

Status: General condition good. *Test meal*: No retention. *Test breakfast* 40 gm; HCl 15, total acidity 45. — *Operation* (1937): Resection of stomach according to Billroth II. 1 cm below pylorus on anterior wall of bulb, a superficial radiating scar. Duodenum abnormally wide.

Resection above angular notch. No ulcer demonstrable. — Healing without complications.

At follow-up 11 years after operation patient states that he considers himself fully recovered and has no symptoms from stomach. Normal eating in respect to number and size of meals; does not diet. Difficulty in digesting milk; after glass of milk nausea and feeling of satiation, though discomfort soon subsides. *Blood status*: Hb. 90 %, red bl. corp. 4.9 million. *X-ray examination of stomach* (1948): The persisting stomach is approximately the size of an orange. No pathologic changes perceptible in stomach, stoma or connecting loop. Emptying takes place at normal rate for this type of operation. After 2½ hours no residue in stomach. (Fig. 2.)

Case 5. Unskilled labourer, aged 19. At age of 14 patient experienced incipient symptoms from stomach in form of regurgitation of sour contents and smarting pain in lower abdomen. Duodenal ulcer observed at age of 15; underwent four weeks' ulcer cure and was symptom-free for three years. Thereafter further symptoms of same type, which returned periodically. During three months immediately preceding admission to Serafimerlasarettet, severe symptoms once again with pain in lower abdomen after meals. Pains also at night. No vomiting. *Extract from status*: Powerfully built man with good general condition. *X-ray examination* (1935): On posterior wall of bulb a niche somewhat larger than a grain of rice. Tone and emptying time normal. *Test meal*: Retention: 30 ml, no lingonberry seeds. Dimethyl 60, phenolphthalein 70. *Test breakfast*: 110 gm; well digested food; dimethyl 70, phenolphthalein 91.

Operation (1935): Resection of stomach and duodenum according to Billroth II + gastrostomy according to Witzel. Posteriorly in duodenum, somewhat towards lesser curvature side and approx. 3 cm from pylorus, was found a stenosing callous ulcer with niche about the size of a pea. Fairly extensive infiltration caudalwards, so that division and invagination were made roughly in the middle of the ulcer. Dependable closure somewhat more difficult than usual owing to infiltration in wall. For safety's sake a tube was inserted against the duodenal stump. Typical operation performed without complications. Patient shows abnormal predisposition to bleed. Healing without complications.

At follow-up 13 years after operation, patient said he considered himself fully recovered; no pain or tension in stomach after meals. Does not diet; eats all kinds of food. *X-ray examination* (1948) shows no pathologic changes in gastric wall; rate of emptying not especially fast.

The most important data relating to these cases have been collocated in tabular form. The series comprises five cases, operated upon at the ages of 15, 16 (two cases), 17 and 19 respectively. All the cases are males with duodenal ulcers. The history ranges between one and five years, and the symptom picture is typical of duodenal ulcer. The pains have been very marked. In four of

Table.

Present occupation	Age at onset of symptoms	Age at operation	Clinical Symptoms	Preoperative treatment	Preoperative roentgen findings	Hospitalisation time after operation	Time since operation
No. 1 Army officer	13 years	15 years	Severe pain. Periodicity. Haemorrhages	Cures at home. Diet	Grossly deformed bulb. Pea-sized niche	14 days	14 years
No. 2 Seaman	15 years	16 years	Vomiting, regurgitation of sour gastric contents. Acute massive haemorrhage. Hb. 33%	Diet at home	Grossly deformed bulb and small niche	12 days	7 years
No. 3 Clerk	12 years	16 years	Pain, vomiting. Acute massive haemorrhage	Cure at home. Diet	Grossly deformed bulb. Massive retention	24 days	16 years
No. 4 Unskilled labourer	15 years	17 years	Hunger pain. Two massive haemorrhages. Hb. 32%	Two hospital cures	Deformed bulb. No niche	14 days	11 years
No. 5 Unskilled labourer	14 years	19 years	Pain. Regurgitation of sour gastric contents. Periodicity	Cures at home. Diet	Grossly deformed bulb + small niche	18 days	16 years

the cases haemorrhages occurred, three of these being operated upon after major life-endangering haemorrhages. In one case, No. 5, there was no haemorrhage but a five year history of severe pains. All cases had undergone cures at home or in hospital without any appreciable and lasting improvement. X-ray examination in each case revealed a grossly deformed bulb. On the roentgenograms three of the cases presented a small niche in the duodenum. Two of the cases with severe haemorrhages had never shown any niche roentgenologically.

Extensive resection of the stomach according to Billroth II was performed in all cases, with retrocolic gastroenterostomy to about

one half of the resection opening in the stomach. The jejunal loop was made very short. No postoperative complications occurred. The patients were discharged from hospital 12 to 24 days after operation.

Quite recently the author follow-up examined all these patients after intervals of 14, 7, 16, 11 and 13 years respectively. The following facts emerged: All five cases are employed full time, one as an army officer, one as a seaman, one as a clerk and two as unskilled labourers. All of them describe themselves as completely symptom-free and in very good health. Two say they experience nausea after milk, but otherwise all five eat any kind of food and take the same number of meals as normal persons. Postcoenal symptoms are altogether absent. The impression gained is that these cases, in respect to food and meals, lead perfectly normal lives. There seems to have been complete adaptation to the changes brought about by the operation. And the roentgenograms from Cases 3 and 4, reproduced below, show that this is not due to any sort of compensatory development on the part of the persisting fragment of the stomach.

All cases except No. 2 were recently submitted to roentgen control. A small residue of the stomach, about the size of an orange, may be observed. No pathologic changes of the gastric wall are perceptible. Passage through the stomach has not been found especially rapid; after two to three hours the stomach has been quite empty.

In two of the cases (Nos. 3 and 4), the gastric juice secretion was examined by means of histamine tests according to IHRE. After the injection of 0.5 mg of histamine, continuous extraction of the gastric juice took place for one hour. Determinations were made after 20, 40 and 60 minutes. Case 3 showed a total absence of free hydrochloric acid and a total acidity value of 10. In Case 4 the HCl value was found to be 30 and the total acidity value 40. In the former case the desired effect has been achieved by resection, namely total achylia, constituting an effective guarantee against recurrences. The other case shows that the stomach, in spite of extensive resection, is capable of producing gastric juice with sub-normal values in respect to the degree of acidity.

The series collocated here is of course too small to provide a basis for any definitive opinion, yet it shows that with the technique employed, *i. e.* extensive resection, excellent results may be

expected even in very young and incompletely developed persons. Moreover, it lends support to the view that age as such does not warrant departures from those principles which apply for adults in the surgical treatment of ulcers.

Summary.

The author takes up the question of the surgical treatment of duodenal and gastric ulcers in young persons between the ages of 15 and 20. After questioning the correctness of the prevailing conservative attitude, he goes on to describe five of his own cases, aged 15, 16 (two), 17 and 19 respectively, on whom extensive resections according to Billroth II were performed. At follow-ups 7 to 16 years after operation, excellent results were noted in all cases. The author considers that by employing extensive resection, fully satisfactory results may be expected even in very young and incompletely developed persons, and that age as such does not warrant departures from those principles which apply for adults in the surgical treatment of ulcers.

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Treatment of Intestinal Gangrene in Infants.

By

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The rapid development of surgery during this century has brought with it a decrease in operative risks and a marked improvement in the results. For a long time, however, the treatment of *intestinal gangrene* constituted an exception to this rule. In a survey published in 1945, GATCH and MONTGOMERY (4) were able to show that the mortality had remained as high as before the pre-antiseptic era. In 1900 GIBSON (5) gave the following figures: in a series of 646 cases of intestinal obstruction the mortality was 47 %, 74 % if resection was attempted. These figures do not differ from those given in the 1940's by, among others, HAY (6) and FULTON (3). The danger is particularly great in infancy. In 1941 LADD and GROSS (8) reported 75 % mortality in 43 cases of intestinal resection and THOREK (11) 80 %.

During the past decade the situation has apparently begun to change for the better. Presumably this is due to more rational treatment of shock and the toxic state and also to certain technical improvements. In connection with a report on three successful operations for gangrene of the small intestine in infants in very poor condition, we should like briefly to summarize the principles of treatment.

The problem in these cases is to:

1. relieve the intestinal obstruction;
2. remove the gangrenous intestinal loop;
3. combat the toxic state, the dehydration, and the shock, and
4. restore the intestinal continuity.

Ad 1. The intestinal obstruction may be allayed by enterostomy, entero-anastomosis, or relieving the intestine with a Miller-Abbott tube. The mechanical obstruction is often combined with so called paralytic ileus, in which event enterostomy or anastomosis may be complemented by such a tube. Our experience and that of others (9) indicates, however, that the intestine resumes its functions more rapidly in infants than in adults (4), for which reason a Miller-Abbott tube becomes unnecessary in these cases. This is fortunate, inasmuch as it is particularly difficult to pass a tube of this type in infants.

Ad 2. Removal of the gangrenous intestinal loop. One may feel tempted to perform resection and primary anastomosis, which would simultaneously remove the gangrenous intestine, relieve the obstruction and restore the intestinal continuity. But to undertake so extensive an operation on an infant in poor condition is still dangerous (75 % mortality (8)). To avoid this risk one may resort to the old method of exteriorizing the gangrenous loop in the wound which lately has been recommended by WANGENSTEEN (13). This exteriorization may be combined with measures, the object of which is to make the operation more radical, namely:

a. enterostomy with insertion of a drainage tube in the afferent loop (recommended by ROSS and JEWETT (9));

b. resection of the exteriorized loop (done by ROSS and JEWETT (9) twenty-four hours after exteriorization);

c. the first stage of a Mikulicz resection, by sewing the afferent and efferent loops together within the abdominal cavity (recommended by HINDMARSH and associates (7));

d. entero-anastomosis before exteriorization (recommended by WAHREN (12)).

Ad 3. To combat the toxic state, the dehydration, and the shock one may utilize in addition the modern arsenal of antibiotics, fluid, electrolytes, proteins or protein substitutes as needed.

Here we shall merely append a statement by HINDMARSH and associates (7): "Large operations of this type on infants are most successful when the child undergoes pre- and postoperative treatment at the hands of a staff familiar with modern pediatric methods."

Ad 4. The restoration of the intestinal continuity depends on the preceding measures, and usually presents no technical problems. This operation should be done early, as soon as one may expect the intestine above the obstruction to have returned to

normal following the ileus. Usually this occurs in a few days — at any rate in our cases we have found the intestine to be normal in less than a week. If one waits longer, the child loses through the intestinal secretion important substances which cannot be wholly replaced. In addition the skin in the vicinity becomes more and more irritated by the intestinal juices.

Probably the main reason for the disrepute into which the old method of simple primary exteriorization of the gangrenous intestinal loop has fallen, is that too long a time was permitted to elapse before restoration of the intestinal continuity.

The principles of treatment which we have adopted are as follows:

In the first operation, our only object has been to save the child's life. All other measures likely to try the child's strength have been postponed. We have attempted to institute natural nutrition as soon as possible (it is particularly difficult to balance the intravenous administration in infants). Finally we have closed the enterostomy as soon as possible. A treatment plan much like that at which we have arrived on the basis of these principles was published recently by ROSS and JEWETT (9).

The treatment includes:

1. pre- and postoperative treatment in accordance with the rules given above;
2. exteriorization of the intestine with insertion of a drainage tube through the gangrenous wall up into the afferent loop;
3. leaving the stomach tube in place, usually only one or two days;
4. possible excision of the gangrenous intestine on one of the following days;
5. at latest a week after the first operation resection of the exteriorized intestine followed by entero-anastomosis. This time is chosen as the child then has recovered sufficiently well to withstand a new operation. If one waits longer, the losses via the intestinal fistula will give rise to difficulties. The operation is undertaken by means of a new incision beside the intestinal fistula.

Case Reports.

Case 1. (Kronprinsessan Lovisa's Barnsjukhus, Surgical Department, 518/46.) A one-month-old boy was admitted April 3, 1946. A mass in the right groin had been observed over a period of four days. The child had cried violently and vomited frequently, with faecal vomiting

on the day of admission. There had been no bowel movement since the day on which the illness began. Upon admission the child was very ill, with grey-eyanotic skin, poor skin turgor, depressed fontanel, and dry mucous membranes. The abdomen was very meteoric. In the right groin there was a strangulated hernia as large as a hen's egg. The serotum was swollen, with numerous petechiae.

The patient was given a blood transfusion of 60 cc. of whole blood together with 100 cc. subcutaneously of equal parts Ringer's solution and 5 % of glucose.

Operation was undertaken immediately (S—m). With the infant under local anesthesia, the intestine was exteriorized and enterostomy performed. The incision was made on the right side corresponding to the external hernial aperture. Immediately an incarcerated, bluish-red discoloured intestine was revealed. The hernial aperture was cut through. *Corresponding to the hernial ring the intestine, a discoloured blackish-grey with definite gangrene, was only $1\frac{1}{2}$ cm. in diameter.* The gangrenous intestine was exteriorized and the peritoneum was sewn around the afferent and efferent loops. A rubber tube was sewn into both the afferent and efferent loops. On the same afternoon the child began to receive nourishment in the form of increasing amounts of breast milk. In addition, for the next five days 100 cc. of equal parts Ringer's solution and 5 % of glucose was administered subcutaneously. On the fourth day the boy received a second blood transfusion consisting of 75 cc. of whole blood, followed the day after by 70 cc. of blood serum.

The child stood the operation well. The next day the shock was relieved, and gradually the circumference of the abdomen decreased. After only a day bowel movements were passed via the intestinal fistula. Two days after the operation there were several slight attacks of vomiting in connection with feeding. A week after the operation the child was considerably improved.

Resection of the lower part of the small intestine and ileocecostomy was then performed (S—m) under ether. An oblique incision was made in the right flank above Poupart's ligament. The afferent and efferent loops were located and divided between ligatures and the stumps were invaginated. Thereafter resection was performed. The proximal stump became discoloured so the resection was continued 1 dm. Since the lower iliac loop was only one finger's breadth long, a latero-lateral ileocecostomy was made. The resected intestinal loop was pushed out through the inguinal canal, after which the peritoneum was sutured from the inside. The abdominal wound was closed in layers. The inguinal canal was also closed with scattered sutures, but there a tube was inserted in the soft parts. During the first half of the operation the patient's general condition was satisfactory but later he ceased to breathe for a while and was in very poor condition. After administration of oxygen his colour improved but he did not regain consciousness and his pulse was not palpable. He was given 70 cc. of serum and 30 cc. of Ringer's solution intravenously. His condition then improved so that the operation could be continued. In the course of it he received another 60 cc. of serum.

Following the operation the patient was pale but cried lustily. His pulse was rapid but of good volume. Only a few hours later he was given breast milk, but after a day he began to vomit repeatedly. A duodenal tube was then inserted and all oral feeding suspended. Via a needle in a cubital vein he received every other hour 30 cc. of serum, 10 cc. of Ringer's solution, and 10 cc. of 5 % of glucose. The hematocrit and serum protein values were followed daily. After only a day it was possible to resume the oral administration of breast milk without further vomiting. Normal bowel movements began two days after the operation. The subsequent postoperative course was uncomplicated. The infant's weight remained stationary for two weeks but thereafter he began to gain normally. He was discharged well.

Case 2. (Kronprinsessan Lovisa's Barnsjukhus, Surgical Department, 460/47.) A five-week-old boy was admitted March 3, 1947. For four days a small lump in the right groin had been noticed. The patient had vomited continuously, during the last two days a more and more evil-smelling greenish-brown fluid. He became worse and worse and during the last day he was too ill to cry. On the last two days he had a number of small, bloody, slimy motions. Upon admission he was very ill, being pale, cyanotic, cold, and dehydrated, with a small, weak pulse. He was afebrile. The abdomen was greatly distended and diffusely rigid. No intestinal sounds were heard. In the right groin there was a firm, very tender mass, the size of a large hazel nut. There was swelling in the right part of the scrotum and blood and slime in the rectum.

The patient was immediately given a blood transfusion with 50 cc. of whole blood, while 300 cc. of fluid, half Ringer's solution and half 5 % of glucose, were administered subcutaneously. Penicillin treatment was also instituted and he was given a massive dose of sulfadiazine.

Thereafter the operation was performed (E—s) — herniotomy + enterostomy. A congenital hernia was found containing an incarcerated loop of the small intestine. The strangulated intestine was badly discoloured and showed a grey constriction, several millimeters wide, corresponding to the hernial ring. No signs of vitality could be observed in the incarcerated loop, which was about 5 cm. long. The gangrenous loop was exteriorized in the wound and the peritoneum sewn around the afferent and efferent loops. A rubber tube was inserted in the afferent loop.

The patient withstood the operation well. At its close a stomach tube was inserted and left in place.

On the following day the patient's condition was better. A small quantity of green, granular fluid was running through the stomach tube. Brownish-black intestinal contents and much gas were passed via the enterostomy. The abdomen was somewhat less distended. On this and the following day the patient was given a mixture of 5 % of glucose and Ringer's solution together with amino acids subcutaneously, altogether 720 cc. per day. The stomach tube was removed after three days and increasing quantities of breast milk were given.

On the fourth day following operation the abdomen was soft and of normal circumference. There were frequent breast milk stools. The child began to lose weight in spite of adequate nourishment.

One week after the operation, on March 10, a second operation was performed (E—s, S—m) under ether. A muscle-splitting incision was made in the right iliac fossa. The afferent and efferent loops were located and it was found that the exteriorized intestinal loop was the terminal loop of ileum. After separation and invagination of the afferent and efferent loops nothing was left of the distal ileum. Since it looked as though the invaginated stump could prevent the appendix from emptying normally, the latter was removed. A latero-lateral ileocecostomy was made. The exteriorized ileal loop was loosened from the hernial aperture and excised. The peritoneum was closed from within. The muscle-splitting incision was closed in layers. The hernial incision was sutured around a drain. The patient stood the operation well.

The postoperative course was free of complications with normal bowel movements directly after the operation. Hence small quantities of breast milk were administered orally on the evening of the same day and rapidly increased thereafter. It was possible to limit the intravenous administration of glucose and Ringer's solution to 500 cc. during the day of the operation and the following day. The hematocrit and serum protein values were normal.

Because of anemia with a hemoglobin of 54 %, a blood transfusion was given five days after the second operation. Six days later the child was discharged; the wounds had healed and his weight had shown a normal increase.

Afterwards the patient was well and gained normally. A month after the last operation he again became ill, with signs of ileus. He was admitted and operated on for ileus from adhesive bands. He withstood the operation well, but another ileus condition set in and the child died a few days later.

Case 3. (Kronprinsessan Lovisa's Barnsjukhus, Surgical Department, 836/48.) A one-month-old, normally developed boy was admitted April 15, 1948. For two days he had lain apathetic, pale, and sunken, crying weakly. For one day he had refused food and vomited a few times. The night before admission his arms and legs were cold. His bowel movements were normal even on the day of admission. Capillary bronchitis was suspected. Upon admission the child was very ill and badly dehydrated, with sunken, blue rimmed eyes, dry mucous membranes, and depressed fontanel. Peripherally he was cold and cyanotic, with moderate dyspnea. He vomited small quantities of bile-coloured stomach contents.

X-ray examination which was immediately undertaken revealed pronounced distension of the small intestine. A low obstruction of the small intestine was considered probable. The child's abdomen was distended and rigid. He was placed in an oxygen tent and given stimulants. Fluids were administered subcutaneously together with sulfa and penicillin. The child's condition was so poor that the prospects of

success were considered nil, but after intravenous administration of dextran he was operated upon anyway.

The operation (E—s) included laparotomy and severance of fibrous adhesions + exteriorization of gangrenous intestine. A right rectus-splitting incision was made on a level with the umbilicus. A thin, fairly abundant, odourless, brownish exudate was found in the abdomen. All the parts of the small intestine were somewhat dilated. The colon was normal and the cecum high up in the right hypochondrium. There was no intussusception. About 40 cm. proximally to the ileocecal valve there was a Meckel's diverticulum as long as a little finger and as thick as a lead pencil. Its apex was connected by a short narrow adhesion to the distal part of the small intestine mesentery. In the ring thus formed about 75 cm. of the terminal ileum and the distal end of the diverticulum were incarcerated and for the most part gangrenous. The greater part of the intestinal gangrene was of the common venous stasis type with dark cyanotic infarcts; within about 1 dm. of the ileum just proximal to the diverticulum there was a greyish, anemic infarct. The entire infarcted area was exteriorized. The intestine was not opened. A blood transfusion was given during the operation, which the child withstood well.

A stomach tube was left in place. The day after the operation the patient's condition was improved, with better colour and hydration. His pulse was rapid but of good volume. The exteriorized intestine, which was distended with gas, was opened in several places. In the afternoon the patient became worse; his colour was poor and he became peripherally cold. After being stimulated with sympatol he improved somewhat. Shortly thereafter he passed gas and a loose, dark bowel movement mixed with blood. On the second day following operation he vomited a few times. 85 cc. of fluid drained through the stomach tube. The patient received 700 cc. of fluid by intravenous drip infusion, of which 50 cc. were blood, 125 cc. dextran, and the remainder a mixture of 5 % of glucose and Ringer's solution. On the third day after the operation he was noticeably better. Nevertheless the abdomen was somewhat more distended and nothing was passed from the exteriorized and opened intestine. To facilitate emptying of the intestine the exteriorized portion was cut away; it proved to be 45 cm. long, 15 cm. were gangrenous, while the rest had been restored. On the fourth day after the operation the secretion through the stomach tube diminished. Still practically nothing was coming from the enterostomy. In spite of this the abdomen was soft and less distended.

The stomach tube was taken out and the infant was given breast milk orally, 10 cc. \times 12. After only a few hours the enterostomy began to function. It is noteworthy that no bile or intestinal juices were passed until the child received oral nourishment.

During the next few days the patient showed rapid improvement. Large quantities of fluid were drained via the enterostomy. An attempt was made to replace this fluid by drip infusion of 5 % of glucose, Ringer's solution, plasma, and blood accompanied by careful checking of the serum protein and hematocrit. A spike of fever on the sixth day was

probably due to thrombophlebitis following the drip. After a week it was considered that the time had come to restore the intestinal continuity.

The operation was performed (E—s, S—m), on April 23 and included resection of the enterostomy, appendectomy, and ileocecostomy. A long muscle-splitting incision was made in the right flank. The afferent and efferent loops to the enterostomy were divided. The ends were doubly invaginated in the ileum and cecum and an appendectomy was performed simultaneously because of the danger of obstructed emptying after invagination of the terminal stump of the ileum. The stumps leading to the enterostomy were freed from the wound made by the preceding operation and removed. A latero-lateral anastomosis was made between the ileal loop and the cecum. The abdominal wound was closed. The operation was concluded with a blood transfusion.

The patient stood the operation very well and as early as the following day he began to take breast milk by mouth. He had several loose bowel movements. Intravenous drip was kept up for three days to complement the supply of fluids. The later course was without complications.

Comment.

Upon admission all three children were in a miserable condition, with the fully developed picture of intestinal obstruction, very toxic and badly shocked. They were regarded as such poor subjects for operation that it was doubtful whether the attempt would be worth while, as they might well die in the course of it. All were operated on in two stages as described above. They recovered remarkably quickly with regard both to general condition and the functioning of the digestive tract. The fact that the intestinal function was restored so soon after 3—4 days' ileus condition illustrates the aforementioned circumstance that the intestines of infants recover more rapidly than those of adults (4).

Unfortunately the second child died a few months later of the results of an adhesive obstruction. This cannot be blamed on the method employed, however — the child had recovered completely from his intestinal gangrene and the subsequent adhesive obstruction ileus might have arisen after any form of treatment.

As has been said, Ross and JEWETT (9) have described a method of treating intestinal gangrene in infants which bears a close resemblance to ours. They report a series of four cases without any deaths. Their procedure differs from ours in the following respects. They regularly resect the exteriorized intestine after twenty-four hours. In two of our cases no disadvantage resulted

from leaving the intestine alone. Furthermore, they restore the intestinal continuity later through the original wound, while we preferred to enter via a new incision beside the intestinal fistula. We considered that this gave us a better view of the operation area, but we would not dare to say which of the two methods is the better. HINDMARSH and associates (7) combined exteriorization of the intestine with the first stage of a Mikulicz resection which was completed later. They report two cases without deaths.

It would appear from the total of nine cases reported by the authors mentioned and by us that the two-stage procedure described is better and safer than primary resection with entero-anastomosis of intestinal gangrene in infants.

An observation of special interest was made in one of our cases and in the two reported by HINDMARSH and associates (7). This was the incidence of shock in connection with the resumption of intestinal function. In our third case the patient improved in the beginning after the first operation in spite of increased abdominal distension. More than twenty-four hours later the first signs of severe shock set in. Shortly thereafter, a bowel movement and gas were passed via the intestinal fistula. In Hindmarsh's two cases this type of course was even more marked. The first child had been operated on with exteriorization of the gangrenous intestine $2\frac{1}{2}$ days after becoming ill. The condition improved steadily for thirty hours after the operation, but the intestine failed to function. Two days after the operation a severe condition of shock, with high fever, set in, so that the patient became moribund. He now began to vomit, and 300 cc. of dark green fluid came up from the stomach. The intestine began to function and abundant stools were squirted out with every peristaltic wave. After a few hours the shock condition began to give way and the child steadily improved. In the second case the course was the same. HINDMARSH (7) finds it interesting that both children were worst off forty-eight hours after operation, with indications of intestinal obstruction which disappeared when the ileostomy began to function.

One of us (10) has previously described and given examples of a type of shock which arises when a formerly "paralytic" intestine begins to function. The reason for this is probably a sudden resorption of the toxins which form and are retained in the distended intestine. Incidence of a condition of shock of this type has previously been described in connection with the sudden relief of a

mechanical obstruction (AIRD (1), Elman (2)). It is probable that the courses of both of Hindmarsh's cases and our third case constitute further examples of such secondary type of shock.

Summary.

Three successfully operated cases of intestinal gangrene in infants in poor condition are described. The treatment consisted of a two-stage procedure: first the gangrenous intestine was exteriorized for enterostomy and a week later resection and anastomosis was performed. The treatment included modern anti-shock therapy. With this plan of treatment similarly good results have recently been obtained elsewhere, and therefore it is probably to be preferred to primary resection with anastomosis, which in children is associated with high mortality. Further examples are given of a type of shock which arises when a previously "paralytic" intestine again begins to function.

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The Surgical Treatment of Ulcerative Colitis.

By

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In all discussions relevant to surgical treatment and its possibilities in ulcerative colitis the characteristics of the pathologico-anatomical changes of the disease in question must primarily be taken into consideration.

1. The destruction of the mucosa of the colon by the ulcerations is in cases with an extensive involvement quite irreparable. The bridges of mucosa between the defects may proliferate and give rise to a sometimes extremely pronounced pseudopolyposis, and if the patient survives long enough the danger of malignant degeneration seems to be greater than previously realized.

2. The inflammatory changes in the colon wall often are deep with cellular infiltration, formation of granulation tissue and shrinkage of the submucosa, muscularis and the subserosa. Shortening, narrowing and straightening of the bowel with a trend towards stenosis result.

3. There commonly arise favorable conditions for a virulent and multifarious secondary infection, which may spread towards the serosa of the bowel.

4. The predilection towards inflammatory complications adjacent to the intestinal tube with perianal and intraabdominal abscesses and peritonitis is life-threatening in the hyperacute as well as in many of the more advanced cases.

5. There are present large risks for focal infection originating from the infected intestine. Especial consideration should be taken to pyodermias with a trend towards progressing necroses

of the skin, paronychias and symptoms from the joints, these later perhaps frequently allergic but also of a pyemic bone-destructive nature.

In approximately 90 % of the cases with ulcerative colitis the process debuts in the rectosigmoid and progresses in the proximal direction, only infrequently involving the lower ileum to any considerable extent. Only approximately 10 % of the cases show the from a surgical viewpoint favorable localization of principally to the right colon.

With regard to the *course* of the ulcerative colitis there should in the surgical evaluation be distinguished between the two principal types.

1. The acute, fulminating form, often as severe as an acute abdominal case and with the poorest possible prognosis.

2. The chronic, remittent type in which periods of recidivation may occur for years, with intervals of comparative freedom from symptoms.

To these may be added a third form with milder symptoms and a marked trend towards recovery. The borderline between this latter and the common colitis is vague. This circumstance explains the difficulty in comparing the various statistics.

In severe cases the ulcerative colitis is highly influential on the fluid, electrolyte and protein balance. Measures directed towards the utmost possible restoration of normal conditions in this respect are urgently called for in the more severe cases and are here not infrequently decisive for the outcome. The recognition of the vast importance of the fluid, electrolyte and protein balance has entirely pervaded our surgical dealings in *e. g.* post-operative cases, but it must be conceded that our service in the case of colitis has not been rational to the same extent. It has during recent years still occurred that patients with grave ulcerative colitis not until the last days of life have received blood transfusion or parenteral saline solution, after during several weeks having been treated with other medical remedies.

We must clearly realize, since the etiology of the disease is unknown, that there as yet does not exist any causal therapy in ulcerative colitis. The chemotherapeutics and antibiotics which during the last decade ever increasingly came into play in the conservative treatment of the disease are thus, although important, merely to be interpreted as adjuvants, their effect

being directed towards the secondary infections always present. Sulfa-G, sulfadigesin, sulftalyl and salazopyrin may all be considered efficacious in combatting the intestinal flora. Penicillin and streptomycin have perhaps been found less effective. They can not be dispensed with, however, in fulminating cases or in connection with the surgical interventions necessary in the treatment of the disease.

Professor SVARTZ has recently presented a series of 290 cases treated during the period 1938—1947. The majority were of the chronic remittent type and merely 4 cases were acute. Death had occurred in 5 cases. Only 4 cases had been surgically treated. To this are added 9 cases of carcinoma, thus a ratio of carcinoma of the colon which with its about 3 % is in contrast with that of the average population, reported as 0.02 %. Out of 124 cases treated only with salazopyrin 90 % were after 2 years improved or entirely free from discomfort. There were 5 deaths from intercurrent diseases.

Our material in Lund is comparatively small but surgical treatment has been carried out in a relatively large extent, and with successful outcome in a fair number of cases. One must, however pose the question whether the operative mortality might not have been lower, if surgery had been carried out earlier, and whether possibly those cases that rapidly went downhill without surgical therapy might have been saved by earlier surgery.

It seems to me that the time has come to take under consideration whether the surgical treatment of ulcerative colitis in Sweden has kept pace with the developments and advances of, for example, the United States. From this point of view our Lunda series possibly may afford some guidance.

The surgical treatment of ulcerative colitis is considered to have been introduced by FOLLET in Lille, 1885. He employed the cecal fistula in order to divert the fecal current from the diseased colon, giving the latter a chance to heal. In order to facilitate colonic irrigation the appendicostomies came pretty much into evidence, on the suggestion of WEIR in 1902. It soon was discovered, however, that the effect was rather questionable and broad cecostomies were instead carried out, preferably with exteriorization of the entire ileocecal flexure, with the object of entirely excluding the diseased colon.

It soon was shown, however, that an effective diversion was possible only through *ileostomy* which is reported to have been

performed for the first time in this affection by BROWN in 1913. In the recent American literature ileostomy is the only procedure recommended in the most common type of ulcerative colitis.

As ileostomy is employed either the double-barrelled or the single-barrelled variant. The former, which is technically easier to carry out, does not exclude the colon quite as effectively but is considered to have the advantage of permitting irrigation of the colon.

Complications of ileostomy are mainly *peritonitis* in association with the intervention. There is a danger of this especially in the fulminating types in which all palpation of the abdomen is condemned so as not to spread the intestinal bacteria immediately under the serosa to the abdominal cavity. Penicillin and streptomycin locally in the abdominal cavity are surely of great value.

Further complications in ileostomy are:

1. Further disturbances of the fluid and salt balances, especially due to the losses at the small bowel evacuations, when the resorption from colon is entirely lost. A particularly abundant administration of salt per os and saline parenterally must therefore be attended to in ileostomy cases.

2. Soiling and irritation of the skin with a tendency towards eczema is the most important and mentally and socially the most troublesome complication for the patient. Owing to this the physician and the patient both have difficulty in making the decision of ileostomy. The best method hitherto of protecting the skin is the American Rutzen bag, a rubber container which is fastened to the skin directly with a specific glue and which may be changed twice daily. The method of Dragstedt, of bringing out the bowel 5 to 10 cm extra-abdominally and making a Thiersch graft on the serosa was, when initially introduced at the Mayo Clinic in 1947, termed by BARGEN as the greatest individual advance in the surgical treatment of these patients. The method, however, is said to be abandoned now. Kaolin powder, and ointments of various kinds are recommended for the protection of the skin and by the diligent changing of dressings and the intelligent cooperation of the patient much can be done to mitigate the inconvenience of the frequent loose evacuations.

3. The formation of abscesses and fistulas around the ileostomy. This complication arises especially if a diseased ileum has been divided. In order to prevent this it is recommended

not to place any sutures through the bowel in fixation to the abdominal wall. Prolapse of the intestinal mucosa or of ileum and herniations result if the abdominal aperture is made too wide and edema with intestinal obstruction results if it is made too narrow.

4. Obstruction secondary to ileostomy has been reported in a rather high frequency due either to kinking or to volvulus.

In view of forestalling these two last groups of complications the methodics for the ileostomy have been elaborated and have by a number of surgeons been brought to such perfection that it is considered necessary to carry out the intervention on an average of $2\frac{1}{2}$ hours (DENNIS).

The double-barrelled ileostomy which does not completely divert the fecal current should only be used in acute cases where the patient is in impending danger and the procedure must be the shortest possible.

A general complication to the surgical interventions in colitis, in addition to the inflammatory sequelae, is also the pronounced tendency towards *thrombo-emboli* which distinguishes these patients.

Most of the American authors consider that the ileostomy which satisfactorily diverts the fecal stream is the most important procedure in the surgical treatment of ulcerative colitis, whether it be the sole intervention or whether it later is followed by colectomy. Owing to the development of the operative technique and methods for post-operative treatment, and the creation of adequate dressings, it is no longer considered to involve too great a discomfort for the patient. It is, however, stressed, *inter alia* by FERGUSON, that ileostomy still is resisted by the majority of the patients and by many of their non-surgeon physicians. He points out, however, that the alternative to ileostomy in grave cases is still worse, and that the intervention no longer should be considered as a desperate measure.

The wider the indications, the smaller becomes the primary mortality, and the more often will it be possible eventually to close the ileostomy later.

The indications for ileostomy may be divided into the urgent and the more relative cases. To the former group belong those with an immediate danger of perforations from the colon, extensive perianal abscesses and massive hemorrhages from the colon. To the more relative cases belong those with diffuse pol-

yposis carrying a risk of malignity, pronounced stricture formation in colon, especially troublesome perirectal abscesses and altogether taken cases of ulcerative colitis that do not improve on medical treatment. Among the more conservative American surgeons, as, *e. g.* at the Mayo Clinic, surgery has been carried out only in 5 % of the cases of ulcerative colitis, while others, as for instance at the Lahey Clinic, operate in 26 % of the cases (CATTELL). CORBETT has operated upon 15 % of his cases.

The *mortality* in ileostomy is reported as being extremely high in the fulminating cases. LAHEY points out that when all are in agreement that ileostomy should be undertaken, the mortality rate is high. In his clinic the mortality rate has during recent years fallen from 26 % to at present 2 %. It was in the 80 first cases that the ileostomy carried a mortality of 26 %. Two-thirds of the deaths occurred in the acute surgical cases but the opinion is that the mortality rate will become much lower here also if the intervention is carried out within 2 to 3 days in the fulminating cases and with the support of antibiotics and blood transfusions.

A pre-requisite condition for surgery is that the patient be in the best possible state with regard to the fluid, protein and salt balance. If the disease already has progressed so far that there is no possibility of making these pre-operative preparations the patient will also be deprived of the therapeutic boon of the ileostomy and the surgeon is placed in an emergency situation. FERGUSON considers that it is not fair to the surgeon to present him with a desperately ill and moribund patient and expect to perform miracles in resuscitation.

The closure of an ileostomy usually is designated a gamble. LAHEY demands rigid requirements in such a procedure. The patient should be entirely free from symptoms over a considerable period of time. The haustration should have reappeared in the roentgenogram, sigmoidoscopy should not demonstrate changes of the mucous membrane, and the patient and his family should be made to fully realize that the restitution of continuity may activate the colitis and eventually necessitate a new and this time permanent ileostomy.

The majority of American authors also consider that a secondary anastomosis between ileum and the sigmoid with or without resection of colon is a remote and improbable possibility on the occasion of establishment of the ileostomy.

In the more uncommon form of the disease (type 2 according to BARGEN) with an essentially uninvolved left-colon ileosigmoidostomy has been recommended as the method of choice. In this case a secondary subtotal colectomy is carried out.

DEVINE has also in the common type of ulcerative colitis, originating from the left colon, recommended a correspondent procedure. In the first stage ileum is divided 15 cm above the ileocecal flexure. The distal end is sewed into a separate incision in the right iliac fossa while the proximal end is implanted into the lower end of the midline incision together with the sigmoid, which has been divided as far distally as possible so that the peripheral stump may be brought forward at the level of the symphysis. The two ends are stitched together and the proximal end of sigmoid is brought forward to the upper portion of the midline incision. Later the spur between ileum and the sigmoid is crushed and subsequently the ileosigmoid opening may be closed and the colon extirpated still later. DEVINE considers that the rectal changes may be reversible when the essentially more widespread changes higher up in colon are removed. He has succeeded with this method in 5 out of 7 cases (1948).

The total or subtotal colectomy is considered the logical procedure in cases of ulcerative colitis that do not recover following ileostomy. Reactivation of a change that remains latent for years in such an isolated colon may occur. The colectomy is still more urgent in cases with a persistent hemorrhage, cases with polyposis and risk of malignant degeneration and cases with focal infections of the isolated colon, such as changes of the skin, symptoms from the joints and so forth.

Extirpation of the lower sigmoid and rectum may generally be avoided but have, however, been performed in a fairly large extent.

It is pointed out by most authors that following colectomy the bowel contents evacuated through the ileostomy will be considerably more solid and less troublesome for the skin and for the patient. We have been able to verify this in all of our cases. Ileum probably takes over some of the resorptive function of the colon.

The mortality figures from colectomy are based on as yet relatively small series. DIXON in 1936 reported 10 cases with 5 deaths after total colectomy, while KAHN in 1942 reported 5 deaths out of 51 such cases.



Fig. 2. Case B. O. Barium enema showing pseudopolyposis,
7 months after ileostomy.



Fig. 3. Case B. O. Specimen of colon.



Fig. 5. Case L. J. Tumor defect of left transverse colon.



Fig. 4. Case B. O. Barium enema 4 months after ileosigmoidostomy.



Fig. 6. Case L. J. Specimen showing obstructing carcinoma superimposed on chronic ulcerative colitis of 17 years duration.

Among our patients at the Lund University Hospital ulcerative colitis seems to have become more common during the last decade. It is difficult to obtain an exact substantiation for this rather subjective opinion, as the diagnostic definition of the condition may be rather arbitrary. In order to obtain a concept of the present situation relevant to the frequency and prognosis of the disease, we have studied and re-examined those cases that during the 8-year period from 1940 to 1947 were treated at the medical and surgical clinics with the diagnosis of ulcerative colitis (*colitis gravis*). There is a total of 54 cases with an average age of 36 years. The majority were treated several times, many already prior to 1940 and some few also under 1948.

Surgery was carried out on 17 of the patients, ileostomy in 6 cases, cecostomy in 1 case and ileostomy + subsequent colon resection in 5 cases. Incisions for abscesses were the only intervention carried out in 4 cases and laparotomy for peritonitis in 1 case.

During the period 1940—1947 13 of the 54 patients died during hospitalization. Among these, 8 patients had been subjected to surgery.

A follow-up for the 41 surviving patients was made at the end of 1948. It was hereby found that 2 had died from their disease, 2 are totally invalidated with constant discomfort, 21 are capable of working to some extent but still have more or less frequent episodes of diarrhea. Four patients are under multiple-stage surgical treatment. Four patients could not be traced. Complete freedom from symptoms is reported by 11 patients. Among these latter 9 patients have had medical treatment only, the 2 remaining also having received surgical therapy (one of these an ileostomy which it was feasible to close).

The period of observation of the cases is varying. In the oldest cases the affection debuted already 20 years ago, while the most recent cases have only had their disease one or two years. With a prolonged period of observation the late results will naturally change, but surely not in a more favorable direction. If the total mortality of the 54 cases is calculated it comprises 28 %. The cases that are entirely free from discomfort comprise only 20 % of the basic material.

A comparison between the results of conservative and of medical treatment are rendered difficult by the fact that we do not have to deal with the same type of cases in the two groups. It is

obviously the especially severe cases that come to surgical therapy. In the present small series the mortality is nearly 50 % in the surgical cases, thus more than three times greater than that of the conservatively treated cases. With a few illuminating examples, however, I would like to establish that the essential cause of the unsatisfactory surgical results is that surgery was undertaken too late.

Ex. 1. A 28-year-old woman died after 1 year of disease, with a rather long remission in the beginning; during the terminal period of symptoms, lasting 2 months, she had a high temperature throughout and had at admission to the medical clinic free abdominal gas, wherefore laparotomy with drainage of an abscess, carried out the day prior to death, was hopeless.

Ex. 2. A 37-year-old woman with symptoms of at least 3 months standing had gradually gone downhill during 2 months of treatment at the medical clinic and was referred to surgery, as free abdominal gas was observed by fluoroscopy. Ileostomy was pointless, as perforation already had occurred and the patient died after 48 hours.

Ex. 3. A 58-year-old woman had a history of 3 years standing with remissions and 3 periods of hospitalization prior to the terminal one; this lasted 5 weeks, 4 of which were spent at the medical clinic with a constant deterioration, the last week being spent at the surgical clinic, where she died 2 days after a double-barrelled ileostomy. Autopsy revealed a general toxic involvement of the organs.

Ex. 4. A 19-year-old youth with a history of 7 years standing and 6 hospitalizations, 2 of which at the surgical clinic, had during his terminal episode, lasting 1 year, become increasingly anemic (Hb 33 %), and was operated upon with double-barrelled ileostomy 1 week prior to death, after having been treated medically without improvement for 6 weeks.

In all of these severe, lethal cases the ileostomy, if performed at least 1 month earlier, would with some probability have afforded an increased possibility of saving the patient.

A similar assumption may be made in the case of at least some of the patients that died during conservative treatment. One example only is quoted:

Ex. 5. A 13-year-old boy at necropsy revealed deep ulcerations in the descending colon with a fibrin coating of its serosa. He had a history of $1\frac{1}{2}$ years standing with 3 free intervals, the last recidivation occurring about 1 month prior to death. He was on this last occasion hospitalized 10 days only, but a surgical intervention might have had prospects of success, if the treatment had been planned as a routine acute abdominal case.

In those 4 cases in which death occurred following ileostomy this had in 1 case only been carried out fairly early (after $2\frac{1}{2}$

months of illness and 3 years after the initial onset of disease). The terminal cause in this 68-year-old male patient was probably a cardiac infarction. In the remaining 3 cases it can now afterwards be recognised that the ileostomy was carried out too late (cf. Ex. 2—4).

Besides the ileostomies that had a lethal course, 2 were carried out with a favorable result. There were in these cases recidivating symptoms with a course over several years (2—5 years). In one of these cases, that of a 34-year-old man, in whom ileostomy was carried out after an anamnesis of 2 years standing, this was closed 14 months later. He is still free from symptoms and in full working capacity now 20 months later, although the roentgenological changes have not disappeared. This happy development, however, must be considered exceptional, and there is no certainty that a recidivation will not occur.

In 1940, furthermore, ileostomy was carried out on a 30-year-old man, who for 5 years had had recidivating symptoms. Metastatic skin necroses appeared 7 months later but healed gradually. His condition has subsequently shown fairly moderate chronic recidivations, which, however, have not kept him from working full time as a shoemaker all of these 7 years despite an ileostomy.

Partial colectomy in stages with ileostomy as the initial procedure has now been performed by us in 5 cases. The indications have been: chronic recidivating symptoms with general deterioration, eventually skin or joint metastases, pseudopolyposis and in one case malignant degeneration.

The first case, operated upon in June 1946, had a lethal course. Death ensued 1 week after the left-sided colectomy, a volvulus of the small intestine being the terminal complication.

In this case the ileostomy was carried out fairly early after an anamnesis of 6 months. It could not, however, prevent the occurrence of, firstly osteoarthritis in the sacro-iliac joint 6 months later, and secondly, recidivating knee-joint involvement after another 2 months. Two-and-a-half years after the ileostomy a left-sided colectomy was carried out with reduction of the rectal stump and exteriorization of the transverse colon with removal of the portion of the bowel that was most involved.

This case shows that the ileostomy was not sufficient to carry the colonic process to such a stage of healing that focal processes could be avoided. Colectomy at an earlier stage would perhaps have had a better result. A division of the resection into stages,

beginning from the right would possibly also have been more satisfactory. This case also shows the quite specific risk of ileus complications during the post-operative course, which also is shown by several other cases in the present series.

The remaining colectomy patients, ranging from 22 to 31 years of age, and all operated upon by the author in 1947—1949, have survived and have shown remarkably slight post-operative reactions, as appears, *inter alia*, by their temperature curves

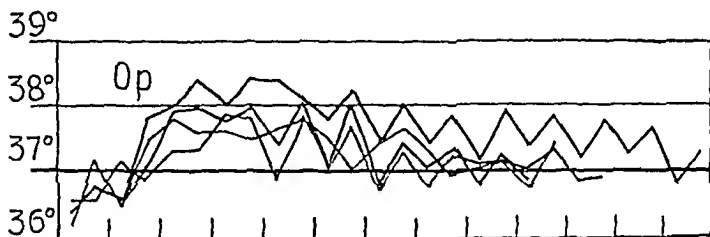


Fig. 1. Postoperative temperature in 4 cases of colectomy for chronic ulcerative colitis.

(fig. 1). One patient (B. O.) was already out of bed the day following the colectomy. In these cases cecum, the ascending and transverse and the descending colon and a large portion of the sigmoid were extirpated in one stage, the lower sigmoid and rectum not being removed.

There was present a pronounced and widespread pseudopolyposis in one of these cases (B. O.) (fig. 2—3). Two months later an end-to-side anastomosis between ileum and the sigmoid was carried out, after which the sigmoidostomy subsequently was closed. The post-operative course was complicated by ileus with a volvulus of the lower ileum above the anastomosis. A new ileostomy was unavoidable, but a subsequent ileo-sigmoidostomy has restored the natural passage with 6 to 8 bowel motions daily without mucous or blood. X-ray shows a satisfactory dilatation of the remaining sigmoid (fig. 4) and the rectal mucosa appears normal at rectoscopy.

A less pronounced pseudopolyposis was found in a second case (T. O.) in which colectomy was performed after symptoms of 6 years standing, and 1 year following ileostomy. Rectoscopic changes are still present, wherefore the possibility of restoring continuity is doubtful. A number of accidents of ileus, in one instance giving rise to laparotomy with debridement, disturbed the course in this case also.

In a third case (A. P.), the effect of the ileostomy was very striking. After recidivating symptoms of 3 years standing the 23-year-old man was in a grave period with multiple necrotic skin abscesses, paronychias, and arthritic symptoms, marked weight loss and anemia. After pre-operative treatment with penicillin and streptomycin, transfusions

and so forth, ileostomy according to Dragstedt was carried out. A rapid improvement set in and 9 months later extirpation of the major portion of colon from cecum to the lower portion of the sigmoid was done. He still has his ileostomy but an ileo-sigmoidostomy is contemplated.

In the fourth and last case (L. J.) the 31-year-old man had had severe periodic colitis symptoms since the age of 15. A moderately severe diabetes debuted at approximately the same time as the colitis. At a routine X-ray-check-up in November 1948 an obstructing cancer of the left portion of the transverse colon was established (fig. 5). No colon cancer symptoms could be differentiated from the old colitis symptoms. Dec. 7, 1948 ileostomy was established and colectomy was done already Jan. 21, 1949 (fig. 6). The post-operative course was remarkably uncomplicated. In this case the prospects of anastomosing ileum to the sigmoid stump should be favorable, as the ulcerations of the bowel are macroscopically healed and microscopy of the site of the inferior division showed slight inflammatory changes only. The prognosis as regards the cancer is more doubtful, due to the fact that lymphatic node metastases were present.

As regards the *operative technique* incision in the right iliac fossa has been employed in establishing the ileostomy. Care should be taken to divide the meso-ileum sufficiently far down to facilitate an easy exteriorization of the proximal end. With observation of adequate nutrition it should protrude a few centimeters from the surface of the anterior abdominal wall, and be fixed by sutures between the mesentery and the parietal peritoneum, not in the bowel wall. It is of importance to avoid kinking. A large caliber catheter may be inlaid during the first days, in order to protect the skin. We have observed beneficial effects from the ointment of Ladd and Gross, which is applied in a thick layer. The distal stump has been deposited in the abdomen without ill effects. Penicillin 2—500,000 I. U. + 1 g streptomycin has been injected into the abdominal cavity before closure of the last suture.

As regards colectomy, this has in 3 surviving cases been done 9 to 13 months after the ileostomy and in the cancer case already after 51 days. A left-sided paramedian incision reaching above as well as below the umbilicus has been made (cf. fig. 7). The extension upwards is dependent on how high the splenic flexure reaches. At this point the delivery of colon is most difficult. Commonly the distal ileum stump has first been located. (Eventual division has been done distal to the ileostomy in cases where this latter has been double-barrelled (T. O.)) The ileocecal flexure has been delivered and the mesentery divided between clamps,

after which delivery has been continued to the left. This has been done rather proximal to the colon wall and the omentum has been permitted to remain, excepting in the cancer case in which the procedure was made as radical as possible. After delivery of the descending colon and the upper portion of the sigmoid the bed has been peritonealized correspondent to the ascen-

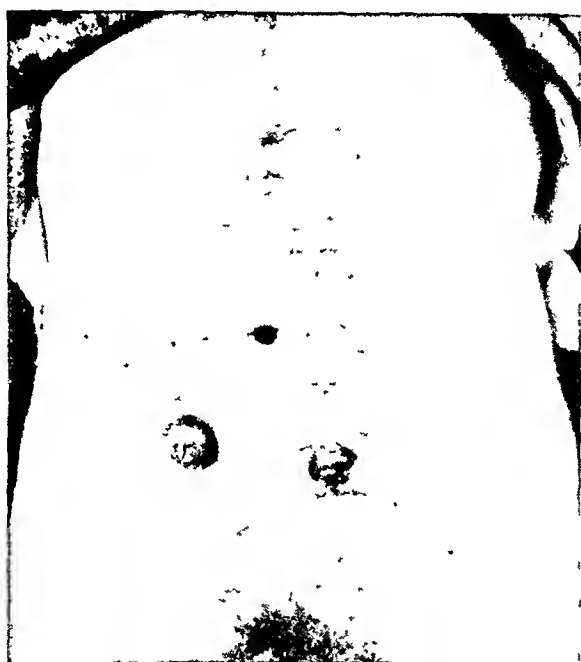


Fig. 7. Case L. J. five weeks after colectomy.

ding and the descending colon. Omentum has been pulled down over the small intestines, as this may have some importance in preventing a postoperative ileus, and the sigmoid has been exteriorized in the lower angle of the incision (fig. 7). After application of a bowel clamp immediately outside the anterior abdominal wall and closure of this, the bowel has been divided distal to the clamp which is permitted to remain for 1 week. No sutures have been made between bowel and peritoneum. Penicillin and streptomycin as in the ileostomy.

In restoring the continuity between ileum and the sigmoid a side-to-side anastomosis seems to be preferable, as torsion hereby more easily is avoided than in end-to-side anastomosis, especially if the intestinal tubes are fixated parallel for some distance outside the anastomosis also.

Summary.

Experiences gained from 54 cases of ulcerative colitis, 17 of which were treated surgically, on the background of the latest surgical literature on ulcerative colitis, justify the following conclusions:

1. While stressing that ulcerative colitis in the majority of cases should be treated medically, the desirability is pointed out of placing the more acute forms of the disease in the same category as acute abdominal conditions with the earliest possible admission to surgical service.

2. The restoration of normal fluid, salt and protein balance is most urgent in these acute stages of disease.

3. In severe acute cases and in certain of the more severe chronic cases ileostomy is a vitally indicated intervention, which deserves a more widespread and earlier establishment than hitherto in this country.

4. Ileostomy is on correct indications and technique and with an improved after-treatment not as socially invalidating as might be believed, and in any event less so than the disease itself.

5. Subtotal colectomy may, it is true, be considered a destructive intervention but is as yet the only therapeutic measure which has been found sufficiently effective in the advanced cases and which in addition does not carry an unduly high mortality.

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From the Clinic of Surgery of the University of Aarhus, Denmark.
(Chief: Professor AAGE NIELSEN.)

Radical Operations for Cancer of the Rectum.

By

AAGE NIELSEN †.

During the term of office of the present chief surgeon (since 1st July 1937) 408 patients with cancer of the rectum have been admitted to this clinic up to the 31 December 1948. During the first years of this period we received these patients exclusively from the municipality of Aarhus; on an average, we had 8 radical operations annually, 47 in all. From 1st January 1943 the hospital has had an agreement with the Danish "National Society for the Relief of Cancer", and from its Radium Centre we have since received rectal cancer cases from all parts of Jutland. Since 1st January 1943 our radical operations have averaged 26 annually; during the last few years we have had approximately 35 annually.

	Not operated	Colo- stomy alone	Perineal amputa- tion	Abdom- inoperi- neal am- putation in 2 stages	Abdom- inoperi- neal am- putation in 1 stage	Total
1938—42.....	28	26	39	8	0	101
1943—31. 12. 48..	43	97	99	59	9	307
Total	71	123	138	67	9	408

Thus a total of 214 radical operations; local excisions with or without posterior rectotomy are not included.

Prognosis: It goes without saying that the prospects of success in the individual case are inversely related to the duration of the cancer. But when the surgeon receives patients for treatment and is to evaluate the possibility of radical operation and lasting curability, neither the duration of the symptoms, nor the size of the tumor is of any great prognostic value.

The duration of symptoms before the admission was almost the same whether the patients were deemed capable of enduring radical operation or not.

Duration of symptoms before admission	0—3 months	3—6 months	6—12 months	over 12 months
Extirpable	39 pts. (50 %)	37 pts. (45 %)	73 pts. (56 %)	50 pts. (42 %)
Inextirpable	39 pts. (50 %)	45 pts. (55 %)	57 pts. (44 %)	68 pts. (58 %)

The percentage of radical operations was thus strikingly uniform in all groups and did not depend on the length of time during which the patients had noticed symptoms; in all cases it was approximately 50 %. If the patients are divided into two groups according to whether the duration of symptoms was less than six months (157 patients) or more than six months (251 patients), it will be seen that 47.3 % of the former group and 49.7 % of the latter were subjected to radical operation, *i. e.* the operability rate was a little larger for patients with *long-standing* symptoms.

On an average, the prognosis following surgical procedures is not better for patients operated upon shortly after the onset of symptoms. On the contrary, our survey of the results shows that the patients who survived for more than 5 years without evidence of recurrence had, on an average, approximately a 10 months' duration of symptoms prior to operation, whilst those who died before the lapse of 5 years had noticed symptoms only for 6 months.

This must be taken to mean that the less malignant, slowly growing rectal carcinomas with late onset of metastases will generally for a long time, occasionally for a very long time, give relatively few and only slightly discomforting symptoms. In practice it means that *the duration of symptoms per se does not give any useful information neither as to whether radical operative procedures are applicable, nor of the prospects of lasting cure.*

The macroscopic area of the tumor on the intestinal mucosa measured on the specimens removed did not either give any useful clue to the chances of permanent cure of the patient. If the specimens are divided into two groups: those originating from patients who survived the operation for more than 5 years without recurrence, and those who died within 5 years, it is found that macroscopically the tumor infiltrated an average of 27.7 and 27 square centimetres respectively, *i. e.* practically the same area.

Thus in the evaluation of success it is impossible to attach importance to these two conditions, which might clinically be expected to afford a certain guidance.

Volume of tumor: It is difficult, if not impossible to determine any figure representing the volume of the tumor. But it is a common experience that rectal cancer may have a very considerable volume locally and may, in addition, infiltrate the adjacent organs (the vagina, uterus, intestines, prostata, ureter, bladder, and the surrounding peritoneum) and yet have few or no metastases and give comparatively good chances of lasting cure. It is not so that the presence of a very voluminous tumor, elicited by exploration, and having been accompanied by symptoms for years, necessarily means that the prognosis is very poor, and at any rate, it must not induce the physician to give up without further consideration. Even though the local finding looks rather hopeless, and the operation may involve great technical difficulties and a higher rate of operative mortality, it is nevertheless possible to secure permanent cure for some of these patients. Not infrequently, long duration of symptoms and a voluminous tumor may indicate a relatively slight degree of malignancy with few or no metastases.

The examination of the form and surface of the tumor provides a better help in the prognosis. Cancers with a "cauliflower-like" surface, voluminous cancers with slight tendency to ulceration, and polypous cancers have an essentially better prognosis than the flat varieties with pronounced ulceration; but in the series presented here there have been exceptions in both directions.

The distance of the cancer from the anus is of a certain prognostic value. Carcinomas in the anal ring itself below the pectinate line cause pain and defecation troubles at an early stage; some of these cases are admitted early to hospital and thus have a relatively good prognosis. If, on the other hand, the site of the

cancer is located to the lesser sensitive rectal mucosa, the lower varieties will give the largest number of recurrences, partly local recurrences owing to ingrowth into the adjacent organs and pelvic connective tissue, partly metastases to the lymph nodes of the lateral regions of the pelvis. If the rectal cancers subjected to radical operation are divided into two groups: The lowest border of the cancer 1) at most 5 cm above the anus and 2) more than 5 cm above the anus, it will be seen that the latter group had approximately 10 % more survivors 5—11 years after the operation.

The site of the tumor in relation to the circumference of the intestine has not given any prognostic clues in our series, the permanent cures being equally distributed over all localizations. It should be expected that posterior cancers, which do not give ingrowth into the vagina, uterus, prostata, etc., would have a better prognosis; but in the series presented here this view has not found any numerical support; possibly, they may give metastases and ingrowth into the retrorectal vessels at an earlier stage.

With regard to the significance of *the age of the patient* for the chances of permanent cure our series lends support to the general opinion that the prospects following successful operative procedures are roughly in inverse relation to the age of the patient, and that the very young patients have a very poor prognosis. With a postoperative observation time of at least 5 years we found that 44 % of the patients who were under 50 years of age at the operation were alive without evidence of recurrence, while patients over 50 years had 63 % without recurrence (*all fatalities are included in "Deaths from recurrence"*, also two elderly patients whom we know died from other causes within the 5 years, and in whom the autopsy showed no evidence of recurrence).

The indications depend on the judgment and experience of the surgeon. It was desirable if it would be possible on the basis of the publications to compare the range of indications of the various clinics; but this is not the case. The ordinary computations of the rate of operability of the patients admitted are only of slight value. This is principally due to the fact that the rectal cancer cases admitted to the various hospitals are of a widely different composition. It depends on the medical facilities accessible to the patients, the extent to which they take advantage of such facilities, and on the thoroughness of the examination and these conditions vary from country to country. Furthermore, it also depends on the extent to which poor objects for operation

have been excluded already before the admission to the surgical department. Such "filtration" of patients takes place to a varying degree through consultations, medical departments, polyclinics, homes for the aged, etc. Transfers from a larger geographical district will tend to increase the number of favourable cases. Clinics which have earned a reputation for their work in the field of rectal surgery will receive a comparatively large number of operable cases referred for treatment from larger districts, and the distinctly inoperable and desolate cases will often have been sorted out before admission. In order that the rate of operability reported shall be of significance for comparison with that of other departments it must at least be based on an account of the composition of the series forming the basis of the computation.

Accordingly it is not surprising that the percentage of cases of rectal cancer subjected to radical operative procedures is reported with figures varying from 25 to 97 %. Even though the actual range of indications undoubtedly differs, and even though it is assumed to be widest in the hands of the surgeons who have the greatest experience in this field, the very high figures show nevertheless that the series forming the basis of the computation must have been "filtered" to a great extent and cannot have comprised the comparatively large number of patients who are admitted to other departments in the terminal stages of the disease, possibly with extensive liver metastases or diffuse carcinosis in the peritoneum.

Our own series of patients 1st Jan. 1943—31 Dec. 1948 shows the significance of this "filtration". It consists of 1) patients from the municipality of Aarhus, from which we receive practically all cases of rectal cancer (106 patients), 2) patients from the rest of Jutland (201 patients). According to our indications 40 % of the former 100 patients and 61 % of the latter 190 could be subjected to radical operation, *i. e.* 54 % of the total series of patients. The larger figure (61 %) must undoubtedly be explained by the fact that some of the hopeless cases have been retained either in local hospitals or in their homes. It is thus seen that it is difficult to find figures which are suitable for comparison of the range of indications. Even in civilized countries with easy access to medical aid it is still probably true that only 40—50 % of the rectal cancer cases can be subjected to radical operation at the time they are admitted to the surgical department. If the indications are extended to comprise palliative operations in cases where

liver metastases or extensive glandular metastases exclude permanent cure, the figure will, of course, be larger.

It is generally agreed that there must be wide indications for radical operations. This applies especially to the local infiltrations of the cancer and its ingrowth into the adjacent organs. It is not an uncommon occurrence to find few or no metastases in such a local infiltration. Attempts must be made to overcome the considerable difficulties frequently attending such cancers, even though the local finding looks rather hopeless. It gives a higher operative mortality, but it is possible to obtain lasting cure for some of these patients. Our contra-indications have been inapproachable metastases, considerable ingrowth into the pelvic connective tissue, and great impairment of general health.

In our series of patients subjected to radical operation 14 had myocardial degeneration, partly with incompensation, 2 ingrowth into the small intestine, 1 also ingrowth into the bladder, 4 ingrowth into the uterus, 1 pseudomyxoma peritonei (from the appendix), 2 also colonic cancer, 1 also breast cancer, 1 apoplexiæ seq. and lues cerebro-spinalis, 1 severe kyphoscoliosis, 2 pronounced emphysema and chronic bronchitis. Of these 28 patients whom we considered poor objects for operation, 4 succumbed postoperatively, 3 died later on, 14 are alive, 5 of whom more than 5 years after the operation.

The age of the patients subjected to radical operation was from 22 to 76 years.

8 patients were under 40 years, 37 between 40—49, 88 between 50—59, 71 between 60—69 (27 of them between 65—69), 10 between 70—76 years.

Advanced age with good general health is no decisive contra-indication, but in very old patients the carcinomas of the rectum will often grow very slowly and may frequently be present for years, causing but little discomfort. A certain reluctance on the part of the surgeon to operate on *very* old patients will therefore be proper.

In the beginning and often far into the advanced stages of the disease cancer of the rectum will often pass undiagnosed because it gives no or only a few and apparently harmless symptoms; accordingly it cannot be avoided that some of the patients present themselves too late for surgical treatment. It must be supposed that the patients themselves are responsible for the greater part of the time lost; but it appears from our series as well as from all other literature on the subject that it happens too often that

the physician does not suspect rectal cancer until long after he ought to — at least it seems so when one is afterwise. It may be reckoned that cancer of the rectum can be palpated by rectal exploration when the tumour goes down to 10—12 cm from the anus; this holds good especially if the patient is instructed to “bear down” during the exploration, by which the tumour is moved one or two centimetres downwards. *Two thirds of our series of rectal cancers were palpable by rectal exploration, but only about one third had been explored at a time when they sought medical aid for symptoms which might give reasons to suspect rectal tumour.*

Operative Results: A few decades ago the mortality rate in radical operations for cancer of the rectum was very high; most frequently it varied from 20 to 50 %, lowest in perineal, highest in one-stage abdominoperineal amputations. Later it has declined very considerably, especially in clinics which have great experience in this particular field, but it has undoubtedly also been affected by the extensive use of blood transfusions during and after the operation and by the knowledge of postoperative disturbances of the fluid-salt balance of the body and their treatment.

In all large series of patients it is evident that the operative mortality declines in the hands of the experienced surgeon (and staff of department).

To illustrate this it may be mentioned that MILES (15) (abdominoperineal) reported a mortality of 35 % in his first series of 100 patients, in the next 100 patients it was 27 %, and in the last 100 patients only 13 %. GABRIEL (3) (perineoabdominal) reported 17 % mortality for his first 100 patients, 6.8 % for his next 146 patients. LAHEY (12) (abdominoperineal) had at first 10.3 %, during the last 5 years 5 %, during the last 2 years 3.9 %. Prior to the agreement with the “Danish National Society for the Relief of Cancer” (1st January 1943) when we had comparatively few radical operations, our operative mortality was about 20 % in a series of 47 patients. Since 1st January 1943 it has been 4.2 % in a series of 167 patients.

The mortality figures reported during recent years from clinics with a wide experience are low, *e. g.* LOCKHART-MUMMERY (13), 1939, perineal, for last 154 patients an operative mortality of 4 %; GULEKE (4), 1941, combined two-stage procedure, last 100 patients 3 %; FINSTERER (2), 1941, last 181 patients, partly combined, partly sacral procedure, 23.7 %; RANKIN (16), 1942, combined procedure, 136 patients, 6.6 %; C. W. MAYO (14), 1943, combined procedure, 276 patients, 6.15 %; GABRIEL (3), 1945, perineoabdominal, 400 patients, 15.5 %; perineal, 650 patients, 10.7 %; HEYDEN (5), 1945, combined, partly one-stage, partly two-stage procedure, 198 patients, 13 %; HULT-

BORN (6), 1945, combined, one-stage procedure, 45 patients, 4.2 %; combined, two-stage procedure, 56 patients, 20 %; TH. E. JONES (8, 9), 1948, combined, one-stage procedure, 1 000 patients, 7.2 %.

The figures cited indicate that it would be an advantage for the patients if endeavours were made to concentrate these operations in a limited number of hospitals, so that it would be possible for the surgeon (and the staff of the department) to obtain the required experience.

It has been the subject of much discussion *which of the two methods of amputation, the perineal or the combined abdominoperineal, gives the highest rate of permanent cures* when due regard is paid both to the operative mortality and the risk of recurrence. The advantage of the perineal technique is that — other conditions being equal — it gives a lower operative mortality than the combined method, although the difference is not considerable in the hands of the surgeon who has a wide experience in this field; the drawback is that by this route it is only possible to remove retrorectal tissue to close to the promontory, whilst in the combined method another 10 cm or more of tissue along the vessels, which are especially threatened by metastases, can be removed. This generally means that the attitude of the individual surgeon to perineal or combined amputation depends on his primary mortality of the two methods.

How many chances of permanent cure do we deprive the patient of by performing perineal instead of combined operation? The question is difficult to answer because it is scarcely possible to procure two uniform series treated with equally good technique. Rectal cancer is in many of the *operable* cases a local process with no or only a few glandular metastases in the neighbourhood of the cancer (40—50 % according to the reports). The incidence of “permanent cures”, *i. e.* no evidence of metastases more than 5 years after the operation, is approximately 40—55 (—60) %, that is to say only 5—10 % higher. It cannot be doubted that *by far the largest number of permanent cures falls into the group where the cancer is a local process, possibly with a few glandular metastases in the neighbourhood of the site of the cancer, and that this applies irrespective of which of the two methods is used.* How much is accomplished by doing combined operation also on cancers located in the lower part or in the middle of the rectum?

GABRIEL (3) has a statement which may serve as a contribution to elucidate this:

Survivors after 5 years.

	Perineal amputation	Combined amputation	Operative mortality
A	82.2 %	83.9 %	0 %
B	61.7 %	62.3 %	5 %
C	17.9 %	31 %	10.7 %
Total	44.9 %	47.1 %	7 %

The groups A and B comprise patients with smaller or larger areas of infiltrations in the rectal wall itself and its immediate surroundings, but in whom no glandular metastases were demonstrated in the specimens removed by operation; the absence of recurrence is large and practically equal in the two methods. Group C had glandular metastases and showed an essentially lower number of permanent cures, but approximately 12 % more in the combined than in the perineal method. For this reason the number of permanent cures for all the patients was 2.2 % larger by the combined operation.

This statement agrees with our experience. *It is hardly a tenable standpoint to reject the perineal method as obsolete as some surgeons do. When due regard is paid both to primary mortality and permanent cures, the best results are achieved by exercising a certain amount of individualization.*

We have done abdominoperineal operation (generally in two stages) on patients with high rectal cancer and also in low cancers where the sigmoid on the roentgenogram proved to be short, so that it might be difficult to draw down a sufficient portion of the intestine for perineal amputation. It has also been used in cases where the local conditions of the cancer gave reasons to suspect that there might be ingrowth into the adjacent organs requiring abdominal approach. In cases where the sigmoid was of sufficient length, and the cancer was located low in the rectum, we generally used perineal amputation, especially in obese or very old patients, or in patients with complicating diseases in other organs (pronounced cardiac conditions, emphysema, bronchitis, kyphoscoliosis, etc.). Gradually as our experience became wider, and as our mortality in the combined method was low, we preferred this procedure in dubious cases. (In two cases we performed GABRIEL's perineoabdominal extirpation; they are included under abdominoperineal amputations.)

During the period from 1st January 1943 to 31st December 1948 307 patients with cancer recti were admitted to our department.

43 of these patients were not operated; 9 died in the hospital.

In 97 artificial anus was established; 21 died in the hospital.

On 99 perineal amputation was performed; 4 died postoperatively (4 %).

On 59 abdominoperineal two-stage amputation was performed; 2 (3.4 %) died postoperatively.

On 7 abdominoperineal amputation in one stage was performed; 1 died.

On 2 primary resection (end-to-end) was performed; 0 died.

Total result: 167 (54.4 %) radical operations with 7 postoperative deaths (4.2 %).

The mortality figure for the radical operations, whether perineal or combined, performed in two stages (at first anus iliacus, 4 weeks or so later radical operation) has been computed in the same way as is generally used in the reports. If the risk involved in these operations is to be compared to that of the one-stage operations, the postoperative deaths following the establishment of the anus iliacus in patients whom it was intended to subject to radical operation should be added. In our series there were 4 deaths, all due to pulmonary embolism, in the cases planned to be subjected to perineal amputation. *When these are included, the mortality rate for perineal operations is 6.6 %.*

That our mortality is less for combined than for perineal operations is undoubtedly due to the fact that the perineal method has been used in several cases where the general health of the patients was unsatisfactory.

On the whole, it holds good of these major operative procedures in patients who are often old or for some other reason in poor general condition that if a mortality rate essentially lower than 10 % is attained for a larger number of radical operations, no conclusions ought to be drawn as to the efficiency of the method or the surgeon from a few per cent more or less. In case of an extraordinarily low mortality the surgeon had better reconsider if his range of indications is not too narrow. In border-line cases it applies that there may be something to gain, but most frequently very little to lose even though the operative mortality is somewhat increased.

Like the operative mortality the frequency of recurrence depends to a great extent on the range of indications. If this is very wide, both the mortality and the frequency of recurrence will naturally become comparatively large.

As examples from recent years of percentages of absence of recurrence after 5 years may be mentioned: GABRIEL (3), perineal operation, 44.9, combined 47.1; LAHEY (12), combined 53; GULEKE (4), perineal

49; KIRSCHNER (10), combined 50; FENSTER and HERMANN (1) (Hochenegg's method) 29.9; TH. E. JONES (8, 9), combined 52; S. HYBBINETTE (7) 44.7—52.3; FINSTERER (2), sacral and abdominosacral 37.9.

The follow-up examination comprises 52 patients subjected to radical operation and discharged after the operation performed during the term of office of the present chief surgeon of the department. These patients have been operated upon prior to 1st November 1943, *i. e.* they have an observation time of at least 5 years. As already mentioned, during the first few years the majority of cases was subjected to perineal procedures. *All patients*, who died in the course of 5 years from the operation, are included in "Deaths from recurrence", even though we know that some of them died from other causes. Information of all the patients is available. At the follow-up examination 28 (54 %) *survived without evidence of recurrence 5—11 years after the operation.*

With the selection of patients which has taken place for perineal or combined amputation, the results of the two types of operation were equally good, but the figures are too small for a reliable comparison. As previously mentioned, our series supports the general opinion that cancer of the rectum in young patients has a poorer prognosis than in older ones. 63 % of the patients who were over 50 years at the operation, but only 44 % of those under 50 years showed absence of recurrence after 5—11 years.

The operations were carried out under spinal-percaïn anesthesia, occasionally supplemented by ether-oxygen anesthesia. For the perineal intervention the patient is placed in Depage's position, inclined 30° on Trendelenburg; a sandbag is placed under the symphysis, so that the pressure on the abdomen is slight. This position gives surprisingly little discomfort to the patient and provides a good view for the surgeon. During recent years a 500 c.c. blood transfusion is given during the operation.

In spite of the perineal wound these patients will almost invariably tolerate *early rising*. Of the 167 patients subjected to radical operation since 1st January 1943 143 were out of bed at latest on the 5th postoperative day. During recent years almost all the patients have been out of bed on the 1st or 2nd postoperative day. As soon as the anesthesia has subsided, the patient is helped into *lateral decubitus in the bed*; this position gives much greater freedom of movement of the lower extremities than the dorsal decubitus. Early ambulation means — in addition to less risk of thrombo-embolic complications — a very considerable

advance. Even after these procedures the postoperative discomfort of the patient is far less than should be expected.

Establishment of artificial anus as the only surgical intervention is undoubtedly still used far too often. A review of our material shows that we ourselves are not blameless in this respect. The old argument that it should be harmful to the tumor that feces constantly pass by rests on a poor foundation. It has also been impossible to demonstrate that establishment of artificial anus in non-ileus cases prolongs life. This surgical intervention should be restricted to inextirpable cancers giving subileus or developed ileus or causing pain with each bowel movement, or possibly incontinence. In other inoperable patients, whether they are frail and only have a short time to live, or still feel relatively well and can possibly live for one or more years, artificial anus will usually mean a useless increase of their discomfort.

Colostomy dressing: To the author's knowledge no satisfactory capsule device exists. In the great majority of patients, whose stools are of a normal consistency, we use a dressing consisting of absorbent cellulose, 10×15 cm and approximately $\frac{1}{2}$ cm thick, covered by a slightly larger piece of several layers of gauze fastened by two transverse strips of adhesive tape. This is held in place by an abdominal support. With normal stools the patient may replace the cellulose when required.

The opinions set forth in surgical literature as to the *discomforts of anus iliacus* differ greatly. Some authors describe them as extremely disabling, others belittle them. The opinions often seem to be influenced by the type of operation, amputation or circular resection, which has been used, and which the author wishes to advocate. There is no doubt that it is far to prefer to artificial sacral anus. We have found that an anus iliacus in approximately 85 % of patients from all classes of society gives little or moderate discomfort when in the course of some months the patients have learnt to adjust themselves to the new conditions.

Nevertheless, there is one very important exception: *The patients who are apt to have loose or liquid stools.* During the first few weeks following the operation this is of little importance since the patient is still in hospital. But in some cases it continues for months or even years; in some of these patients it lasts for a few days with longer or shorter intervals, in others the trouble is almost incessant. Some will get a satisfactory con-

sistency of the stools in the course of some months or years, partly spontaneously, partly by a suitable regulation of the diet (consisting of avoiding such food as the individual patient knows by experience will result in diarrhea), and partly by administration of obstruents. But there are still a few per cent left whose trouble cannot be relieved. In most of these cases it holds good that also prior to the disease they have had a chronic tendency to diarrhea with or without any demonstrable intestinal disease. *Of 125 patients who at the follow-up examination were questioned especially on these conditions, 16 stated that they were more or less inclined to loose or liquid stools; in some of them it was a tolerable discomfort, in others a serious disability. In patients who prior to their rectal cancer have been inclined to diarrhea, it is therefore of paramount importance if possible to save the normal sphincteric mechanism.* In high rectal cancer cases where resection approximately 3 cm below palpable tumor and end-to-end anastomosis is possible, this is undoubtedly the method of choice. In lower cancers there is no satisfactory solution. The methods of resection which only in 50—70 % of the cases will give *full* continence can scarcely be advocated. Diarrhea through an insufficient anus perinealis is even worse than through colostomy.

Summary.

An account of 214 cases of radical operation for rectal cancer is given. The duration of symptoms before the admission to hospital does not give any clue to operability or the prospects of permanent cure. The same applies to the area of macroscopic infiltration of the tumor on the intestinal mucosa. On the other hand, the distance of the cancer from the anus, the form and surface of the tumour have a certain prognostic significance, likewise the age of the patient (under 50 years of age: 44 %, over 50 years: 63 % survivors without evidence of recurrence more than 5 years after the operation).

During the years 1943—1948 54 % (167 patients) of the 309 patients admitted were subjected to radical operation. 99 underwent perineal amputation with 4 % operative deaths, 59 abdominoperineal operation in two stages with 3.4 % operative deaths, 7 abdominoperineal operation in one stage with 1 death, 2 primary resection with no deaths; total: 167 radical operations with 4.2 %

operative death. With the indications used for the two methods there was found to be practically the same percentages of "permanent cures" (54 %) in perineal and abdominoperineal operations after an observation time of from 5—11 years. The great majority of the patients endured early rising on the 1st, 2nd, or 3rd postoperative day. Approximately 85 % of the patients had surprisingly little discomfort from their colostomy; approximately 13 % were more or less inclined to have loose stools or diarrhea.

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Some Observations on the Removal of Kidney Stones Particularly by Means of Pyelolithotomy in Situ.

By

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After the first nephrolithotomy was performed by MORRIS in 1880 and the first pyelolithotomy by BECK in 1881, these two methods caused great controversy and gave rise to lively discussions during a number of years, concerning the advantages and disadvantages of the two different operations. Forty years ago BORELIUS in an article in *Folia Urologica* wrote that nephrotomy may have been the dominating operation during the last years and in many hospitals the only method used for the removal of stones in the kidney, but according to his opinion this was wrong. BORELIUS on his part meant — certainly relying on a very limited amount of material — that pyelolithotomy was preferable in all cases where it could be used, *i. e.* when the stone was not too big, when it was situated in the lower part of the pelvis, when it could be palpated and when the kidney could be lifted out of the lumbar incision. Since then, as everyone knows, the necessary conditions for pyelolithotomy have been mitigated and this operation has more and more superceded nephrolithotomy. Investigations by HEDENBERG of the operations on kidney and ureter stones in Swedish hospitals during 1911—1938, show that nephrolithotomies have decreased from 37 % to 11 % at the same time as pyelolithotomies have increased from 22 % to 34 %. Still more apparent is the supremacy of pyelolithotomy in the material from the surgical university clinic, Karolinska Sjukhuset, where, during the years 1940—47, 45 % of the operations on stones in the kidney were pyelolithotomies and only 5 % nephrolithotomies.

The causes of the supremacy of pyelolithotomy may, in the first place, be due to greater risk of postoperative bleeding that follows nephrolithotomy and which often make a secondary nephrectomy necessary. In a material from the Maria Hospital in Stockholm, there occurred, between 1911—1939, 9 cases of severe postoperative bleeding after 65 nephrolithotomies, *i. e.* in nearly 14 %, as compared with only one case after 122 pyelolithotomies. In 6 of the bleeding cases after nephrolithotomy a secondary nephrectomy was necessary. As a cause of the altered relations between nephro- and pyelolithotomy must be reckoned the improved diagnosis that brings patients suffering from stones in the kidney, earlier to the hospitals for treatment, when the stones are often small and suitable for pyelolithotomy. Against pyelolithotomies there is the objection that they are more often than nephrolithotomies followed by postoperative leakage of urine with risk of infection and eventually persistent urine fistula. This was also the case in the above-mentioned material from the Maria Hospital, in which leakage of urine for a longer period occurred four times after pyelolithotomy, as compared with only once after nephrolithotomy. When deciding which operation is the most suitable for the removal of stones in the kidney, it is necessary to take care, not only of the immediate risk of the operation, but also of the risk of recurrence. As the author has pointed out in several papers, there are many different opinions, often due to incomplete follow-up regarding recurrence after operations for stones. In the above-mentioned material from the Maria Hospital, which has been thoroughly followed up, the frequency of recurrence was 25 % when both real recurrence due to newformed stones and false ones, from calculi left behind at the operation, are collected together. Recurrence on the operated side after pyelolithotomy appeared in 15 % by aseptic and in 48 % by infectious stones and after nephro- and nephropyelolithotomy in 33 % by aseptic and in 60 % in infectious cases. Also as regards the risk of recurrence in this material, the nephrolithotomies have given a worse result than the pyelolithotomies, which indeed may partly be explained by the fact that nephrolithotomy has been specially used by larger coral stones with branches in the calices where a priori the risk of recurrence from fragments of stones left behind is great.

The mortality following operations for stones in the kidney and ureters has steadily decreased. While in the Maria material

it was as high as 5.5 %, it was only 1.2 % in the material from the Karolinska Sjukhuset. The causes of this are many, as for instance, improved prophylaxis and treatment of thrombosis and infection, improved anesthesia, adequate fluid- and ion-balance, which need not be dealt with in detail at this time. The question is, however, to what degree the risk of recurrence has decreased. In the material of the Karolinska Sjukhuset the time of observation is still too short to estimate the risk of recurrence. It appears, however, to have decreased compared with that of the Maria material.

As has been noted the usual method for removal of stones in the kidney has been pyelolithotomy. Only occasionally has nephrolithotomy been adopted, and that only when the stones have been so situated in the calices that they were impossible to extricate with pyelolithotomy. Also larger coral stones with branches in calices and stones situated deep in the renal pelvis have usually been removed merely through pyelolithotomy, thanks to the technique that has been employed. The most important principles of this technique are that the kidney is not loosened from its surroundings and brought out of the lumbar incision, but only rotated in situ so as to make the posterior wall of the pelvis accessible, and that the edge of the hilus is lifted up by means of special hooks, so that pyelolithotomy in larger or smaller degree can be performed intrarenal. This method differs in certain aspects from what is usually given in urological textbooks. Most authors as YOUNG, EISENDRATH and ROLNICK, SWIFT JOLY, WINSBURY-WHITE and MARION declare that by doing a pyelolithotomy, the kidney has to be completely loosened from its surroundings so as to be brought out as far as possible. A pyelolithotomy in situ has been regarded as an emergency measure in cases where the kidney, for one reason or another, as a short pedicle or adhesions, cannot be mobilized and brought out. RUMPEL meant, however, that under favourable conditions, the kidney may be only partly freed and mobilized, and an Italian surgeon, CHIUNDANO, wrote in 1942 that he always made a pyelolithotomy in situ, reporting 64 of his own cases with good results.

The author has, during the last 8 years, regularly used this method, because the author has found it as easy to make the posterior wall of the pelvis accessible and to extricate the stones with the kidney in situ, as after mobilisation of it, and because

the avoiding of this has certain advantages. With a pyelolithotomy in situ, an unnecessary trauma to the kidney and its surroundings is avoided, and the risk of breaking of fragile and ramified stones, or the displacement in calices of stones that at the

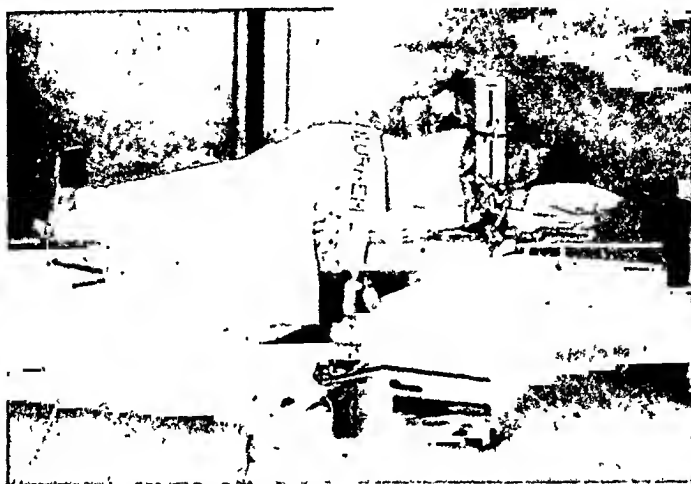


Fig. 1. A patient on the operating table with the arm fastened on the frame onto which also Rissler's hook will be fixed.

beginning of the operation have been situated in the saccus, are diminished.

To do a pyelolithotomy in situ, it is very important that the lumbar incision is large enough. We use the common oblique lumbar incision and lift the upper margin of the wound with Rissler's hook, which is fastened on a frame that is fixed onto the operating table and that also keeps the patient's arm fast (Fig. 1). That arrangement has proved itself very useful for all kidney operations because it gives good space and saves assistants. By the kidney placed rather high and by a long 12th ribbon a piece 1 cm-long from its posterior part is resected.

In cases where the extrarenal part of the pelvis is well developed and where the stone is not too big, a pyelolithotomy is easy to perform and needs no further commentary. In pelves chiefly intrarenally situated and in larger coral-shaped calculi, a pyelolithotomy will of course be more difficult. Many authors recommend, as above mentioned, that in such cases it is better to do a nephrotomy or a so-called "py  lolithotomie   largie" after MARION, *i. e.* prolong the pelvis incision through the margin of the hilus into a calyx, a method that indeed entails a certain risk of severing

of the artery which usually runs parallel with the hilus and often between the lip of it and the pelvis. Serious haemorrhage and necrosis can follow this, because this artery is often of large calibre. In cases of intrearenal pelvis or larger coral-shaped stones the author used to do a blunt dissection with the help of Lister probes and curved clamps between the pelvis and the margin of the hilus avoiding severing of this said artery. The posterior lip of the hilus is then lifted up by means of a thin metal spatula that can be curved into suitable hooks (Fig. 2—3).¹ It is astonishing how, in this way, one can explore the intrarenal part of the pelvis. By means of the curved spatula, the kidney can also be lifted up sufficiently without mobilizing it from its surroundings. If the pelvis, as is often the case, is covered with sclerotic fat, this will be severed and put aside by means of the above-mentioned spatula. In such cases it is often easier first to explore the upper part of the ureter and from there to work up to the pelvis. The incision of the pelvis ought to be made high up, so that the following suture is covered as much as possible by the lip of the hilus. This should be a good protection against leakage of urine and formation of fistula.

For the extraction of isolated smaller calculi the author ordinarily uses gall scoops. In the case of larger calculi and coral stones with branches in the calices, the author makes use of Lister probes with which the stones are loosened from the wall of the pelvis and carefully extricated. In stones or staghorns inside a narrow neck of the calyx, this can be widened by means of a clamp or cut with a knife.

After the stone or stones have been removed, the calices are thoroughly examined in order to see whether any calculi have been overlooked. It may happen that such can be found without their having been visible on the X-ray plate before the operation. If one is uncertain about all the stones having been extracted, an X-ray should be taken during the operation of the exposed kidney. With the film wrapped in tinfoil and put into a sterile glove, it is usually easy to place the film behind the kidney without mobilizing this or drawing it out of the lumbar incision. Recently, from the Roentgen clinic in Lund, a flexible cassette has been invented which also contains an intensifying screen and seems to be very useful.

After the stones have been extracted, the pelvis has to be irrigated with potassium permanganate boric acid solution with

¹ BABICS in Budapest has recently described a similar method.

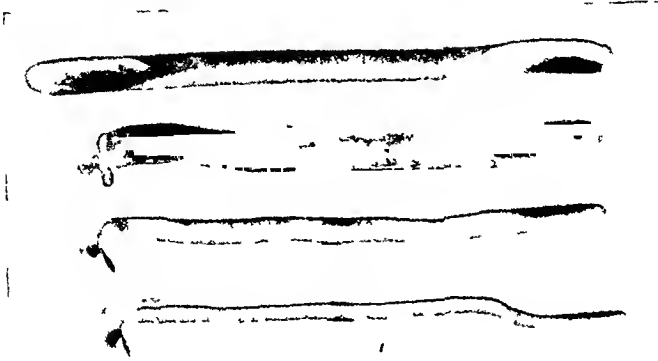


Fig. 2. Metal spatula which can be curved into suitable hooks for lifting the posterior lip of the hilus.

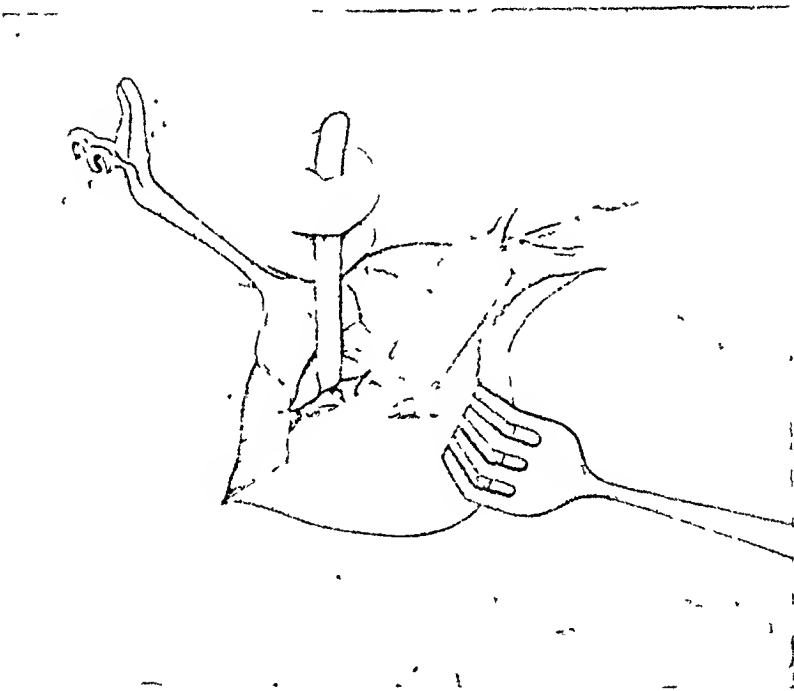


Fig. 3. Schematic picture of a pyclothotomy. The upper margin of the lumbar incision is lifted by means of Russler's hook and the posterior lip of the hilus with a curved metal spatula.

the object of removing any unnoticed stones or fragments of stones, or any debris or clots. It is indubitable that these can form the nucleus of a recurrent stone, which the author has observed in some cases, one of which is noted in an illustration in fig. 4, where the stone can be seen as a shell covered on the inside with a dark membrane giving blood reaction. The object

should be to do as little damage as possible to the mucous membrane of the pelvis and to stop the haemorrhage as completely as possible. The author ordinarily has used small sponges dipped in 3 % peroxide of hydrogen to wash out the mucous membrane of the pelvis, which on the one hand should stop the haemorrhage and on the other remove from the mucous membrane small stone fragments, debris and clots.

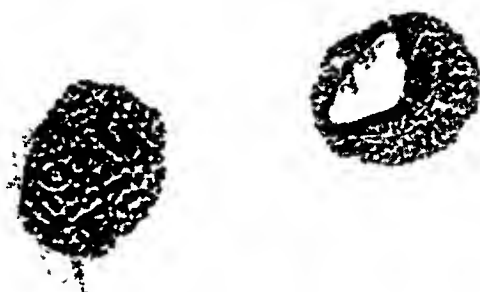


Fig. 4. A recurrent kidney stone formed round a blood clot.

Some surgeons have abandoned the suturing of the pelvis incision after pyelolithotomy. As a reason for this MENNA and others declare that in animal experiments the non-sutured incisions healed without leakage of urine, whereas this occurred frequently in the sutured cases. In a clinical material on the other hand, SCHNITMAR found no difference regarding the postoperative leakage of urine in the sutured and the non-sutured cases. The author has regularly sutured the pyelolithotomy incision in the belief that it would be the best way of also preventing a temporary leakage of urine. Whether one sutures or not, it seems to me that a pelvis incision covered by the lip of the hilus ought to be the best way of preventing a leakage of urine. When suturing, it is important to use fine absorbable catgut, otherwise there is the risk that a recurrence stone may be formed around an unabsorbable catgut thread lying free in the pelvis. The author has given an example of this in one of his earlier articles. Drainage of the pelvis the author has only occasionally used, and that in cases of infection or in a higher degree of dilatation of the pelvis and particularly when a residual urine is feared. A remaining infection

or a newly developed one in connection with the operation, especially with urea-splitting organisms, is perhaps the most common cause of real recurrence. It is therefore very important to fight the infection by means of sulfa, penicillin or streptomycin.

Earlier on in this article, the author mentioned that leakage of urine occurred more often after pyelolithotomy than after nephrolithotomy. In our material, leakage of urine after pyelolithotomy took place in 19 % of the cases. The causes of a leakage of urine from the sutured pyelotomy incision can be many *i. e.* obturation of the ureter from swelling, clots or stone fragments, necrosis of the margins of the incision or maladaptation of the latter. We can avoid some of these causes or reduce them by a thorough technique, but some, in spite of this, cannot be avoided. In cases where the leakage of urine is copious and when it lasts longer than a week, then it is important to catheterize the ureter and leave the catheter in place for several days. If the leakage of urine should persist after removal of the catheter, it should be reinserted. In one of the author's cases the catheter was inserted on the ninth day after the operation and left for six days, after which the leakage of urine ceased. In another case the catheter was inserted on the seventh day and left for three days, after which the dressing remained dry. In a third case the catheter was inserted on the eighth day, but the leakage of urine continued, due to the fact that the catheter did not reach high enough. On the eleventh day after the operation, the catheter was inserted under X-ray into the pelvis, after which the leakage of urine ceased. After removal of the catheter on the third day, the leakage of urine started again. Another catheter was inserted and left in place for seven days with the result that the leakage definitely stopped.

Summary.

The author recommends not to loosen the kidney from its surroundings in pyelolithotomy and not to bring it out on to the loin, but only to explore the upper part of the ureter and the posterior wall of the pelvis with the kidney in situ. Working up between the pelvis and the lip of the hilus, this is lifted up by means of metal spatula, which can be curved into suitable hooks. The incision of the pelvis should be done as high up as possible, so that the suture will be more or less completely covered by

the lip of the hilus. With this method also, larger coral stones or calculi in the intrarenal pelvis can be removed. By a pyelolithotomy in situ, severing of the kidney, fragmentation and dislocation of calculi will be avoided, which decreases the risk of recurrence. In cases of persistent leakage of urine after pyelolithotomy, it is recommended that a catheter be inserted in the ureter up into the pelvis and left in place for several days.

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Chemotherapy in the Present Day Rational for the Treatment of Genito-Urinary Tuberculosis.

By

EINAR LJUNGGREN.

A recent follow-up of patients operated upon for renal tuberculosis at the hospital of Stockholm from 1934 to 1943, which is to be presented in detail in the immediate future, does not show substantially better results than the follow-up investigations presented in Sweden in 1925 by SVEN LUNDBERG, MAURITZ PERS-SON, and others. Our endeavours to improve the results of our treatment of renal tuberculosis through early diagnosis and early operation have thus not been rewarded by the success anticipated. Other workers, notably BEAUFOND, NESBITT and BOHNE, have recently had similar experiences. We must therefore pursue another policy and learn to look upon renal tuberculosis not as a local disease but as a local manifestation of a general disease. It is accordingly necessary that the surgical treatment be combined with medical and hygienic treatment, that is, a sanatorium regimen. The importance of this has increased since the introduction of various chemotherapeutic agents for combatting the tuberculous infection, PAS (para-amino-salicylic acid), Streptomycin and TB I 698 (DOMAGK).

We must discard the doctrine of the famous French urologist, ALBARRANS, "Tuberculose rénale = néphrectomie immédiate" and so, during recent years, we have come to an individual treatment of renal tuberculosis. In the relatively infrequent cases in which there is present only a minor change in the pyelogram and no cystitis we do not now perform an immediate nephrectomy. In-

stead, the patients are treated with PAS and sanatorium care with the anticipation of getting the tuberculous process to heal. Not until we are able to establish a noticeable progress of the disease in the kidney or until cystitis has occurred do we perform nephrectomy.

In the obvious more advanced unilateral cases of renal tuberculosis, especially in the presence of cystitis and when there are no other active extra-urogenital foci, as a rule we perform nephrectomy, which, however, is not usually synonymous with an immediate nephrectomy. It must be considered of importance in urogenital tuberculosis as well as other forms of tuberculosis, firstly to diminish the risk of dissemination of the disease in connection with the operation and secondly for the attainment of better results in healing, to postpone operation until the tuberculous infection is in a more quiescent, that is, less active stage, "Néphrectomie opportune", BEAUFOND.

How then are we to decide when this is the case? The clinical course, the sedimentation rate, the temperature and the blood picture will often give us valuable information in this respect. This does not however suffice, but recently we have gained a new resource in the BARGE BOURGAIN reaction, which according to our experience, recently presented by BERGLIN and SIEVERT, must be considered of definite value in the assessment of the grade of activity of the tuberculosis. By consistently giving the patient PAS before, during and after the operation we hope to be able to diminish the risk of spread of the tuberculous infection during operation.

In these cases in which the patients with renal tuberculosis also have extra-genital lesions, such as bone or lung disease, we do not operate as a rule, but only when these lesions are in a healing stage. Consequently, there is a fairly large number of patients who are placed under sanatorium treatment prior to the nephrectomy and practically all receive such treatment subsequent to the operation. Within recent months virtually all of these patients have been under sanatorium care for some time before the operation and all have received PAS. When feasible we endeavour to give these patients post-operative sanatorium treatment until they are free from symptoms and the guinea-pig inoculation is negative.

Tuberculosis of the male genital tract is now commonly considered to be secondary to renal tuberculosis. The primary gen-

ital focus, as recently demonstrated by BORTHWICK among others, is located in the prostate or seminal vesicles, the spread of the disease to the epididymis taking place in most cases, via the vas deferens. In these cases in which the patient does not simultaneously have renal tuberculosis and epididymitis an asymptomatic tuberculosis of the prostate or the seminal vesicles will rarely be diagnosed. If incidentally, or due to slight diffuse symptoms, involvement of the prostate and seminal vesicles is established, the differential diagnosis between a chronic non-specific and a tuberculous prostatitis or vesiculitis may sometimes be extremely difficult to determine. In such cases, an examination of the semen may afford valuable guidance, as shown by my assistant OLA OBRANT, who, in a case of incidentally discovered mild pyuria, found the guinea-pig inoculation test of the urine after prostatic massage to be negative but positive for the semen. If, however, a patient has renal tuberculosis, one may be practically certain that the nodules palpated or the cavities roentgenologically demonstrated in the prostate or the seminal vesicles, are of tuberculous origin. To a great extent we now perform a prophylactic vasectomy on such patients in an attempt to prevent the occurrence of epididymitis. If there are palpable changes in one lateral prostatic lobe and one seminal vesicle we perform vasectomy on that side only. If already there is present a unilateral epididymitis, it will be seen that it subsequently becomes bilateral in more than one half of the cases. Therefore like BORTHWICK, we nearly always perform vasectomy of the healthy vas deferens in unilateral epididymitis, if the opposite seminal vesicle is involved or if bilateral prostatic involvement is established. Analysis of the semen is carried out in nearly all cases of epididymitis in order to throw light in doubtful cases on the indication of vasectomy. It may be pointed out in this connection, that in a series of 65 cases of tuberculous epididymitis published by the author in 1939, it has turned out that only 3 of the patients operated upon for unilateral epididymitis have become fathers.

The routine treatment for tuberculous epididymitis is radical, that is, epididymectomy or orchidectomy. If the vas deferens is markedly involved we perform total vasectomy at the same time and occasionally also remove the seminal vesicles. In epididymitis also, especially in the acute forms, the patient is usually treated by a sanatorium regime and PAS, in the hope of improving the healing results which are appreciably poorer than after neph-

rectomy. These patients are subsequently given a post-operative course of treatment with the object of healing the tuberculous process in the prostate and the seminal vesicles.

Our patients receive this sanatorium care in a recently established genito-urinary tuberculosis service at *Rävlunda Sanatorium*, situated 40 km from Gothenburg. All examinations and operations are carried out at the surgical clinic, the chief of which is appointed visiting urologist to the sanatorium. All the patients at the sanatorium have been treated with PAS.

It is as yet far too early to assess the results of this treatment. It already appears however, to be favourable in several cases. In five bilateral cases of renal tuberculosis the urine has been negative on guinea-pig inoculation after three to seven months treatment with PAS. In one of these cases treated by PAS for ten months, there is pyelographic evidence of a regression of the disease and the patient's serious discomfort from the cystitis has entirely disappeared. In all of the cases with one exception in which there was present a contracted bladder, the discomfort from cystitis has entirely disappeared or has improved considerably with PAS treatment. In one case of unilateral renal tuberculosis which had treatment with PAS for four months after one and a half months of calciferol treatment pathological examination of the kidney removed showed such marked signs of healing that it is probable, in my opinion, that the tuberculous process would have healed on continued chemotherapy.

The dosage of PAS in renal tuberculosis has, as a rule, been 2×4 g per day. That dosage had to be increased to 10 or 14 g daily in several men with genital tuberculosis, in whose urine the tubercle bacilli persisted after the first dosage. Recently the treatment in some instances has been combined with chaulmoogra oil and streptomycin.

LINDÉN, at the annual meeting of the Swedish Surgical Association in 1948, demonstrated a case of primary renal tuberculosis which had been treated with PAS for six months prior to the nephrectomy and in which the tuberculous process was in a healing stage. LINDÉN, therefore, considered that it would have been better in this case, if the nephrectomy had not been carried out. ODELBORG, on the same occasion, reported a case in which cystitis, pyuria and tubercle bacilli in the urine occurred six months after nephrectomy for renal tuberculosis. A tuberculous lesion was seen in the remaining kidney (destruction of the upper

calyx) and a large tuberculous ulcer of the bladder was also found. After 2½ months treatment with PAS, the patient became free of symptoms, the pyuria had disappeared and the ulcer in the bladder had healed, the change in the calyx, however, remaining.

STOBBAERT (1947) reported favourably on the effect of calceferol in renal tuberculosis, since the general condition of the patients improved and the urine, in some cases, became free of pus and tubercle bacilli. NESBITT and BOHNE (1948) reported a case of renal tuberculosis with bilateral destructive lesions in which the patient, after a seventy-days treatment with streptomycin, passed urine which was free of pus and organisms and in whom the pyelograms about one year later showed no abnormalities on the right side and evidence of a massive cicatrix on the left side. These workers concluded "that it is now evident that we should treat all patients with urinary tuberculosis by prolonged sanatorium care and streptomycin therapy whether the infection appears to be clinically bilateral or unilateral". At the latest meeting of Association Française d'Urologie in October, 1948, E. WILDBOLZ and VAN KURBERGEN reported that they had achieved healing of a tuberculous cystitis in a short time by the combined treatment of chaulmoogra oil and streptomycin. The chaulmoogra oil was considered to have the property of dissolving the capsule of the tubercle bacillus, whereby the effect of the streptomycin became stronger.

From these results, it now seems that we have efficacious remedies for assisting patients with all forms of urinary tuberculosis, including bilateral renal disease, tuberculosis of the remaining kidney and tuberculous cystitis. It follows that patients with a tuberculous condition, which earlier was only slightly amenable to treatment can now derive considerable benefit. It is probable that by a combination of chemotherapy and sanatorium regimen, we shall be able to effect the healing of early cases of renal tuberculosis so that we need less often perform the mutilating operation of nephrectomy in such cases. As THOMAS, STEBBINS and RIGOS express it, "The victory in surgical treatment is not the removing of an organ but in saving it."

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Renal Tuberculosis and its Treatment by Partial Resection of the Kidney.

By

CARL SEMB.

1. General remarks on the treatment of renal tuberculosis.

The treatment of uro-genital tuberculosis has for many years been partly active surgical; partly conservative medical. Surgical treatment has always been in the forefront as the pre-eminent method; while on the other hand conservative medical treatment has played a subsidiary rôle being limited merely to palliative measures.

This attitude to treatment has to some extent contributed to the division of renal tuberculosis into two separate clinical types:

- 1) The surgical type.
- 2) The non-surgical medical type.

1) The first group, the surgical type, has played such a dominant part in the discussion that renal tuberculosis as a whole is known as "surgical tuberculosis".

There is plenty of evidence that this group represents, to a large extent, a selection of cases with slowly developing ulcero-cavernous disease, frequently unilateral, occurring among patients in relatively good general condition with few other clinically apparent manifestations of tuberculosis. Such a selection has been made naturally because it has been dependent on a selection for operative treatment of those patients who were suitable for it. It is this form of renal tuberculosis which has constituted the main background for our clinical and therapeutic experience with the disease.

It was on a basis of such material that ALBARRAN taught: Renal tuberculosis begins as a rule on one side. Renal tuberculosis does not heal spontaneously.

This has led to the stereotyped treatment of unilateral renal tuberculosis by unilateral nephrectomy; while medical treatment has played a more modest part.

Surgical treatment by unilateral nephrectomy in selected cases has resulted in cure of between 50 %—60 % — relatively higher for women than for men. BULL, EKEHORN, ROVSING and RUNEBERG demonstrated this with their combined statistics in 1925. More recent figures (LJUNGGREN, CIBERT, ROSENDAHL) have been little better in spite of better diagnostic methods, and earlier treatment.

Death, in those cases not cured, is in some caused by extra-renal tuberculous lesions and in some tuberculosis of the other kidney — which shows that renal tuberculosis is but part of a general disease and that it is frequently bilateral. This tendency to be bilateral is further shown by the 15 %—20 % of the usual surgical material which are found to be bilateral from the first, and for whom we have been able to do nothing. The close connection with extra-renal tuberculous lesions is best demonstrated among the non-surgical group of cases.

2) The non-surgical form of renal tuberculosis has formerly been little studied. This has partly depended on the fact that these are more or less severe cases of renal tuberculosis in which the treatment of the renal disease has to take second place to that of the more dominant manifestations of the disease, such as bone and joint tuberculosis, pulmonary tuberculosis or “miliary” renal tuberculosis, etc., or cases where the diagnosis has been doubtful.

From autopsy material we know that the frequency of renal tuberculosis is much greater than one would expect from clinical experience; varying in different groups of statistics between 1 % and 8 %, frequently bilateral and combined with other tuberculous affections.

These figures show that it is probable that a proportion of cases of renal tuberculosis are overlooked clinically. They are either not diagnosed at all or are diagnosed too late to come into the category of “surgical” tuberculosis. This in itself depends on the fact that renal tuberculosis runs a latent course, giving few prominent clinical symptoms which would call the patient's or physician's attention to it. It is the onset of the complications, such as hae-

maturia, ureter and bladder tuberculosis, tuberculous epididymitis and so on, which give alarming symptoms. And these are often late manifestations in the development of the disease.

The Swedish surgeon LJUNGGREN has been able to show that the number of nephrectomies for renal tuberculosis in Sweden has increased considerably. In fact it has more than doubled in the fifteen years from 1932 to 1946, in spite of the fact that the death rate from pulmonary tuberculosis has decreased to one quarter during the same period. This increase is supposed to be due essentially to better diagnostic methods, particularly intravenous urography and retrograde pyelography, though the possibility of a real increase cannot be denied.

In general it may be said of the treatment of renal tuberculosis:

The unilateral surgical approach by which treatment has been characterised, has produced modest results. Medical treatment has not been systematically used. A considerable proportion of cases have had no treatment because diagnosis has been lacking. Renal tuberculosis is not only a surgical problem, but constitutes a general medical question of great practical importance and interest.

Genital tuberculosis in men has an intimate connection with renal disease and must be considered in relation to it.

Our general attitude to renal tuberculosis has been more active in recent years with systematic urine examinations for bacilli, and better roentgen diagnosis; but in general it may be said that the same systematic care has not been devoted to the treatment of renal and genital tuberculosis as pulmonary tuberculosis, in which it has given such excellent results.

There is a long way to go before our Health Authorities, general practitioners and hospital doctors use the same energy in this problem as is devoted to pulmonary tuberculosis, in respect of notification and registration, systematic mass diagnostic attempts, hospital and sanatorium treatment of suspected cases and active follow-up of the cases from year to year. Mere examination for bacilli in the urine leaves much to be desired and can in no way be likened to the systematic work done on pulmonary tuberculosis. Here is a great field awaiting revision.

2. Special medico-surgical treatment of renal tuberculosis.

The treatment of a single case of diagnosed renal-tubercle, as has been mentioned, has been relatively stabilised based on

ALBARRAN's dictum. But this problem also demands reconsideration and has been under discussion again in a number of clinics. As a working hypothesis I think that it might be useful to draw a parallel between renal tubercle and pulmonary tubercle — to examine the possibility of employing like principles with renal

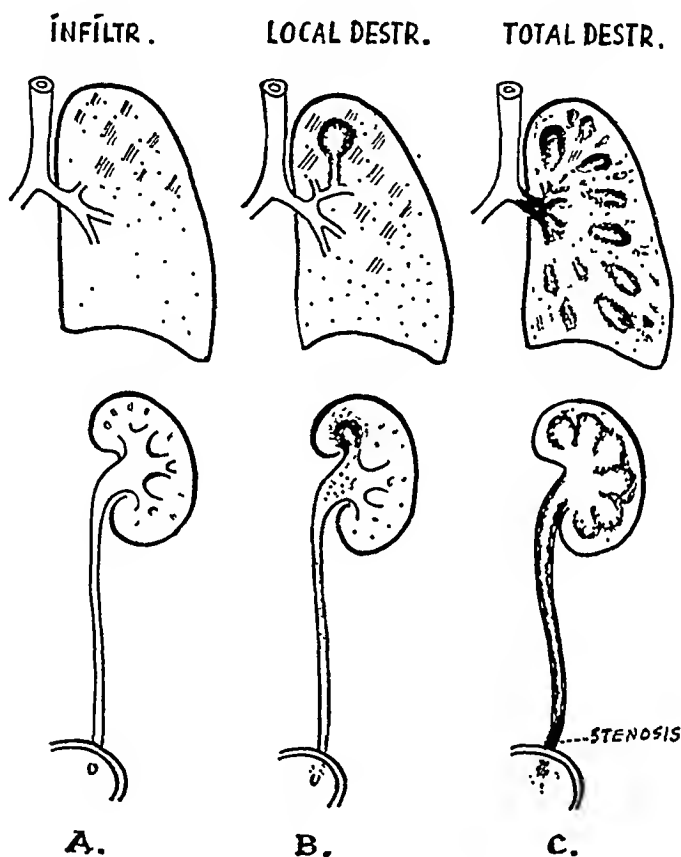


Fig. 1.

A. Infiltration without macroscopic destruction. B. Local destruction.
C. Total destruction.

tuberculosis as those which have given such good results with pulmonary tuberculosis.

Senior Physician H. J. USTVEDT and colleagues have, in Norway, described the modern view of the pathogenesis of the disease, pointing out the general haematogenous nature of the infection as well as the later clinical manifestations in the course of the disease. This is a development of the teaching of HJ. HEIBERG. We need more information but we believe that the infection begins with multiple small infiltrations or tubercles particularly

in the cortex, of which some heal while others become the starting of macroscopic destruction especially in the papillae. Pathological anatomy shows many similarities between renal and pulmonary tuberculosis. These pathological aspects of the disease may be classified into two principle groups in both conditions:

1) Infiltration without macroscopic destruction (as in the "parenchymatous" form of renal tubercle).

2) Cavity formation by macroscopic break down of tuberculous tissue. (The "ulcerocavernous" form of renal tuberculosis.)

1) Infiltration without destruction in the lungs we know may be encapsulated or resorbed, depending on the patient's resistance to the disease. Such infiltration is to some extent a reversible process. Some of the newer pathological investigations of the kidney (MEDLAR et al.) have shown that healing of small non-destructive foci may also be found here, in that small residual scars may be found. It is believed that this form of renal tuberculosis may heal spontaneously, or with medical treatment. Foci of this type do not give macroscopic perforation to the renal pelvis but are seen microscopically to be in connection with the renal tubules and thus may be the cause of bacilluria. This is an interesting connection with the much discussed question of "excretion bacilluria".

It is commonly believed that the presence of tubercle bacilli in the urine from the ureters implies a tuberculous focus in the kidney, but it may be only microscopical. This may represent the anatomical basis for excretion bacilluria. This has great clinical importance in that it implies that the excretion of tubercle bacilli by a kidney does not necessarily mean that the kidney has progressive ("surgical") tuberculosis.

This type can sometimes be diagnosed clinically by the demonstration of tubercle bacilli with a normal intravenous and retrograde pyelogram.

2) Macroscopic foci of destruction — cavities — represent in the lung a (clinically) more serious form of pulmonary tuberculosis. The cavities are the seat of the tuberculous process and from them the disease spreads to other parts of the lung, bronchi, larynx, and intestines.

Destruction in the kidney can reasonably be considered in the same way. It starts as a rule at the base of the papillae with destruction and cavity formation and perforation into the renal pelvis. Thence the infection spreads to ureter, bladder and oc-

casionally the urethra, and, in men, the genitalia; analogous to the spread from a lung cavity to bronchi, trachea, larynx and intestines.

The spontaneous healing of a macroscopical cavity in the kidney is even less common than in the lung; so uncommon indeed that in practice it need not be reckoned with as a possibility. Rare instances have been described of healing by, for instance, blockage of a calyx by scar tissue, which is analagous with occlusion of the drainage bronchus in the lung.

On the other hand the development of the condition is very variable. Sometimes relatively rapid, sometimes exceedingly slow through many years, up to 30 years for instance.

Bronchial tuberculosis and stenosis of a main bronchus leads to severe secondary changes in the lung with total destruction. Tuberculosis of the ureter and stenosis has a similar effect on the kidney leading to pyonephrosis and total destruction.

Renal tuberculosis may be divided into three main groups:

- a) Without macroscopic destruction.
- b) With local destruction.
- c) With total destruction.

These similarities between pulmonary and renal tuberculosis invite the use of the same principles in the handling of the two conditions. Briefly, in pulmonary tuberculosis one uses the following principles. For all types — medical treatment.

- a) Infiltration without macroscopic destruction — medical treatment.
- b) Local destruction — local surgical treatment.
- c) Total destruction — total collapse or total extirpation.

We shall now see how the same general principles may be applied to the treatment of renal tuberculosis.

General Medical Treatment.

In the first place, sanatorium treatment may be supposed to be of importance in renal tuberculosis to build up the patient's resistance against the widespread disease which tuberculosis represents, particularly in patients with other extra-renal sites of infection. Cases of this sort have, as shown by recent statistics, a much worse prognosis than those with more localised disease (ROSENDAHL).

In the kidney itself one may suppose that medical treatment may be valuable — namely in cases with small or microscopical infiltrations, without macroscopic changes — which in any case tend to heal as we have seen. Swedish and French workers have made claims for the increasing use of medical treatment of renal tuberculosis and this question ought in my opinion to be taken up in Norway. It is of great importance to try sanatorium treatment of renal tubercle to a far greater extent than at present. Treatment with specific drugs has been of particular interest in recent years. A number of these have been produced — Vitamin D and the Swedish preparation P. A. S. can, according to LJUNG-GREN, give bacilli free urine and improvement in the pyelogram. But the follow up is still short.

Streptomycin has been of considerable interest since the reports of a number of good results. Its combination with Chaulmoogra oil has been recommended by American and French workers. It seems clear that streptomycin has a considerable effect on renal tubercle, but it is difficult to judge how effective it is in an individual case, likewise the duration of the effect. Streptomycin, as is well known, is short-acting and one might expect it to be least effective in macroscopical destructive lesions. One is entitled to expect that the drug would be of considerable value in small non-destructive lesions analogous with those in the lung; and possibly also in the secondary localisations in the renal pelvis, ureter, bladder, etc.

One must await with great interest the results of the combination of medical treatment and streptomycin, particularly in the early forms of the disease. One may anticipate the same results of combined streptomycin and surgical treatment as we have seen in pulmonary tuberculosis. The drug brings the patient into a better phase in his illness, toxæmia diminishes, and it seems to have a marked power to prevent the spread of infection in the post-operative period. In this connection we have tried the combination in renal tubercle, and have found it, as far as one can judge, to be of very great value during the operative treatment of this disease.

Surgical Treatment.

As is well known, total nephrectomy has been the recognized treatment for unilateral renal tuberculosis without regard for the pathological anatomy, that is:

- a) Small areas of infiltration without macroscopic destruction.
- b) Local destruction.
- c) Total destruction.

Unilateral nephrectomy may be likened to total thoracoplasty as done 20 years ago. In recent years this has been succeeded by a more selective treatment aimed at the macroscopic destructive cavity, leaving the non-destructive infiltrations to the organism's own powers of healing. Closure of cavities is followed by the formation of fibrous scars, and resorption of areas of infiltration. The same may occur in foci in the bronchial tree, larynx and intestines.

In Department III, Ullevål Sykehus we have tried to carry out the same selective principle in dealing with local macroscopic destructive foci — cavities — in the kidney, and not include in this therapy small areas of infiltration in the renal parenchyma or the secondary spread to renal pelvis, ureter and bladder. Collapse therapy of course cannot be employed, but it is possible on the other hand, locally to excise the cavity with the tissue immediately surrounding it.

Such a procedure has the following advantages: a) It spares functioning renal tissue. b) It makes bilateral surgical treatment possible. c) It puts the minimum post-operative strain on the other kidney.

The anatomical arrangements of the kidney allow of partial nephrectomy, for it is a segmental structure of which part may be removed without damage to the remaining part. A single segment of kidney has its own end-arteries; while the pelvis (analogous with the bronchial tree) has branches leading to large and small calyces.

Kidney resection is an operation which has been tried for a number of local conditions as well as for tuberculosis but it has been little used because of the following complications: a) Bleeding from the parenchyma. b) Post-operative urinary fistula. c) Wound infection. d) Diminished function of the remaining part of the kidney owing to the damage done to it during the operation.

Partial resection of tuberculous kidneys has been done to a limited extent until now — the few attempts that have been made having had, on the whole, unfortunate results (Urinary fistula, spread of disease). It has been generally abandoned in tuberculosis. The *reasons* why we can now take this question up again are many:

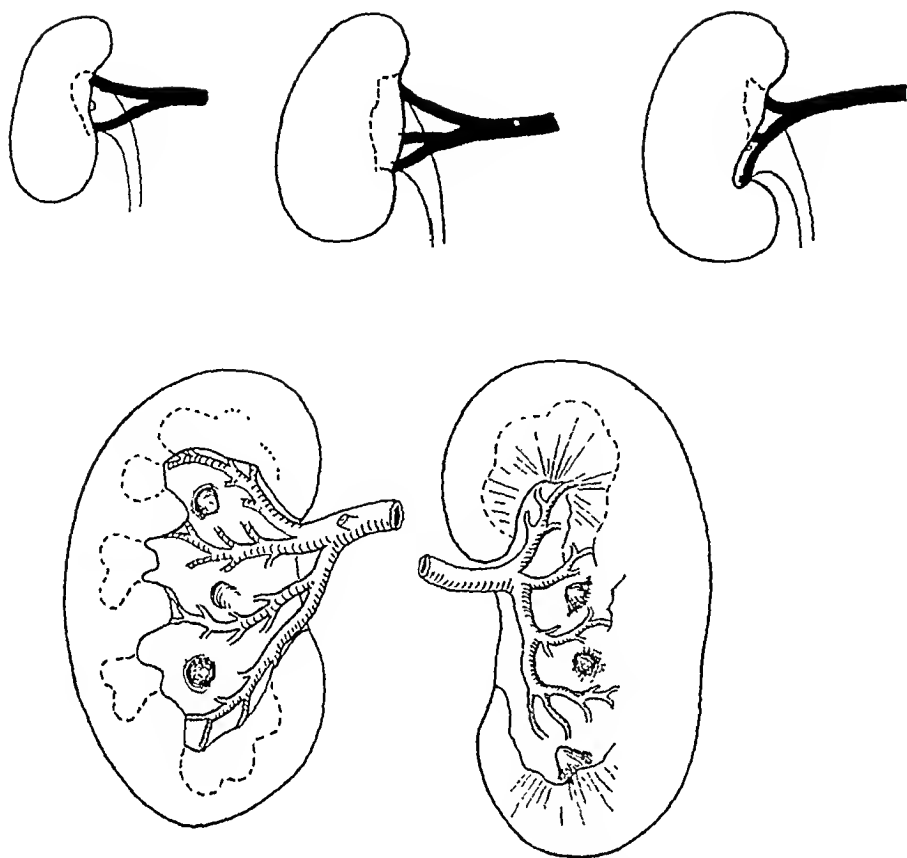


Fig 2. The division of the main arteries of the anterior and posterior part of the kidney. (Schematic drawing.)

a) *Considerable accuracy in the diagnosis* of the extent of the destruction within the kidney has been attained so that one may decide with relative exactitude what one should remove.

Scandinavian authors such as R. STEINERT and OLLE OLSSON have made a thorough study of the value of intravenous urography and retrograde pyelography in this respect. To these investigations may be added aortography as a supplement. However these tests do not give such certainty as in pulmonary tuberculosis. In our material we have found on the whole very good correspondence between Roentgen diagnosis and the pathological specimen. In one case however we found an abscess that was not in communication with the renal pelvis, and that therefore was not visible in the pyelogram. In another case the destruction was less than supposed from Roentgen examination.

b) *The use of streptomycin* and other specific drugs as a protection against spread of tuberculosis in the postoperative period.

c) *A safe operative technique.*

We have tried to work out by means of dissection of a large number of kidneys from autopsy material a safer operative technique based on the segmental anatomy of the kidney. The renal vessels play an important part in this connection. They are very



Fig. 3. Incisions bilat. kid.-res.

variable outside the hilum, but within, the distribution to the segments is constant. Ligature of these segmental vessels prevents bleeding and avoids damage to the rest of the renal tissue.

At the hilum also, the local divisions of the renal *pelvis* to the segments may be dissected out. It can be divided and sutured separately so that the danger of urinary fistula is minimal. In the same way as in closing a cut bronchus the suture line is covered with connective tissue from the hilum and a little fibrin foam.

The incision in the renal parenchyma is closed with a double suture with fibrin foam between the apposed surfaces, and covered by sewing up the renal capsule, to prevent loss of blood and urine.

The carrying out of this relatively minute technique can only be done through a good exposure. Up to now we have used an *anterior incision* (Fig. 3) which makes it possible to mobilise the kidney and swing it forward in the wound; we also clamp the

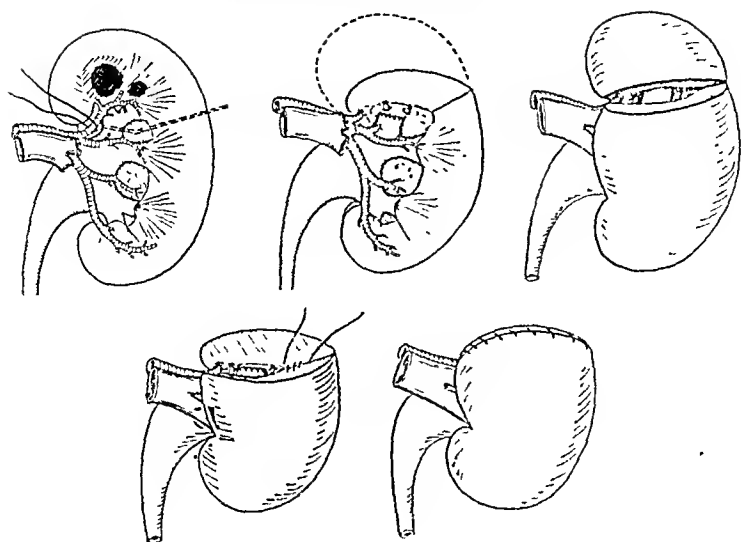


Fig. 4. Resection of upper pole of left kidney. (Schematic drawing.) Individual ligation of vessels — and resection of one calyx with suture in the sinus.

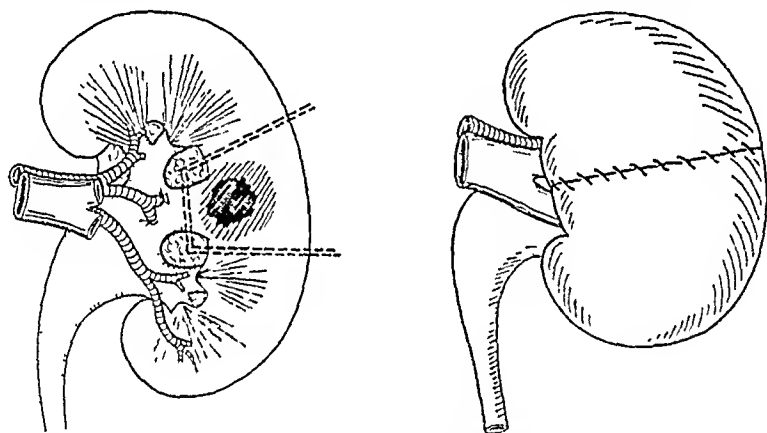


Fig. 5. Resection of medium part of the left kidney. (Schematic drawing.) Individual ligation of vessels — and resection of one calyx with suture in the sinus.

renal pedicle with a forceps so that one is working with a bloodless organ.

VAN SLYKE and his colleagues have shown experimentally that it is possible to clamp the renal artery for as much as 3 hours without doing permanent damage to renal function. It is depressed for some time after such clamping but recovers relatively quickly. In our cases we have clamped the renal pedicle for as much as $1\frac{1}{2}$ hours, as a rule $\frac{3}{4}$ to 1 hour without evidence of permanent damage. The technique has proved itself efficient with several non-tuberculous local conditions, such as pyelogenic cysts, local destruction of renal tissue by calculi, and in tuberculous infection.

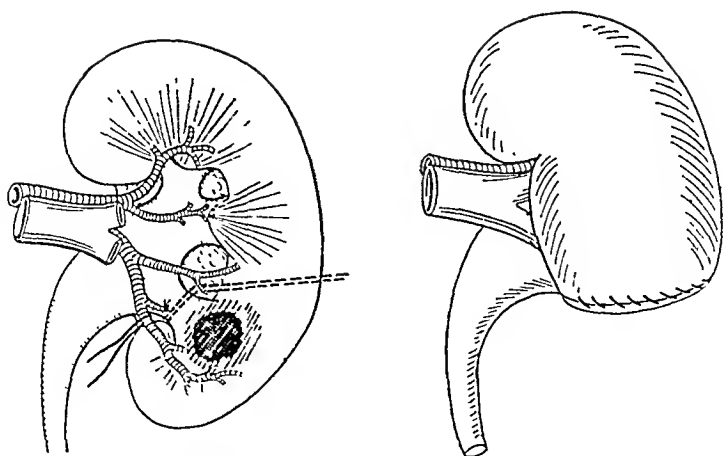


Fig. 6. Resection of the lower pole of the left kidney. (Schematic drawing.)
Individual ligation of vessels — and resection of one calyx with suture
in the sinus.

As may be seen, 3 different types of resection may be used: resection of the upper pole (Fig. 4); resection of part of the middle (Fig. 5), or resection of the lower pole (Fig. 6). In one case both upper and lower poles have been resected leaving only the middle part. Partial resection for tuberculosis has been carried out on 14 patients during about one year. The following operations have been performed:

Resection on one side	10 cases
» » both sides	2 »
» » one side plus extirpation on the other..	2 »
	<hr/> 14 cases

Resections have been performed as follows (see Fig. 7):

Resection of the upper pole	10 cases
» » the lower pole	2 »
» » both upper and lower	1 »
» » middle part	3 »
	<hr/> 16 cases

Mortality. Nil. *Complications.* Wound infections 3 times with tuberculosis, of which 2 have healed and one is improving.

Urinary fistula	} Have developed in no case.
Post-operative bleeding	
Post-operative spread of disease	

Transient renal insufficiency was seen in 3 cases.



Fig. 9. Case 1. After operation.

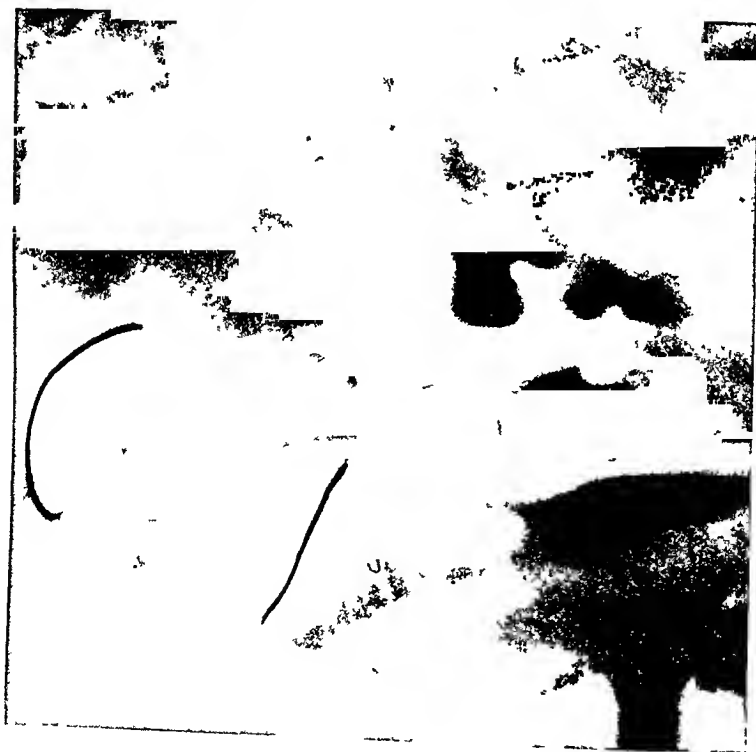


Fig. 8. Case 1. Before operation.

SEMB: Renal Tuberculosis.



Fig. 10. Caso 8. Before operation.

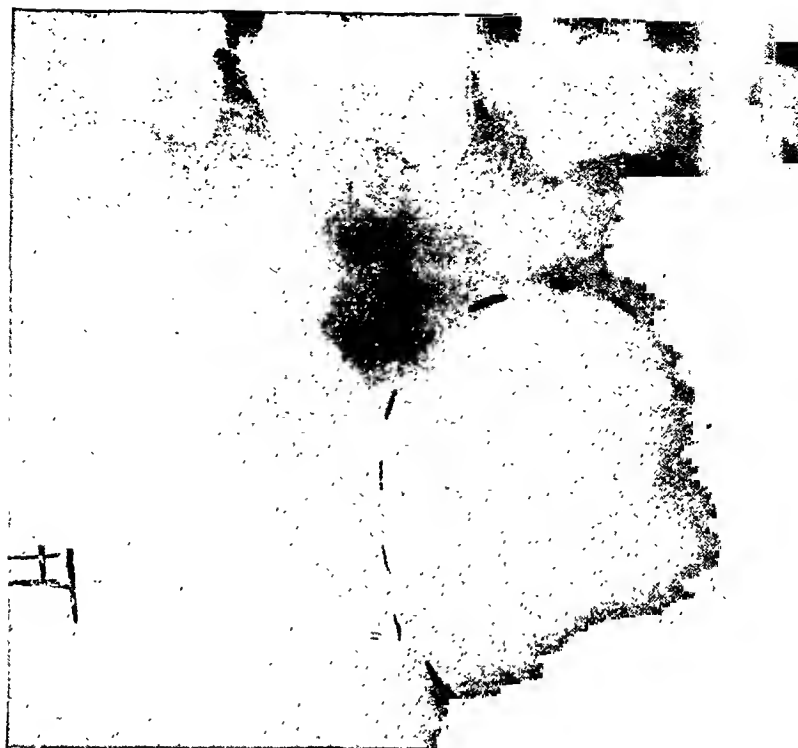


Fig. 11. Caso 8. After operation.



Fig. 12. Case 5. Before operation.

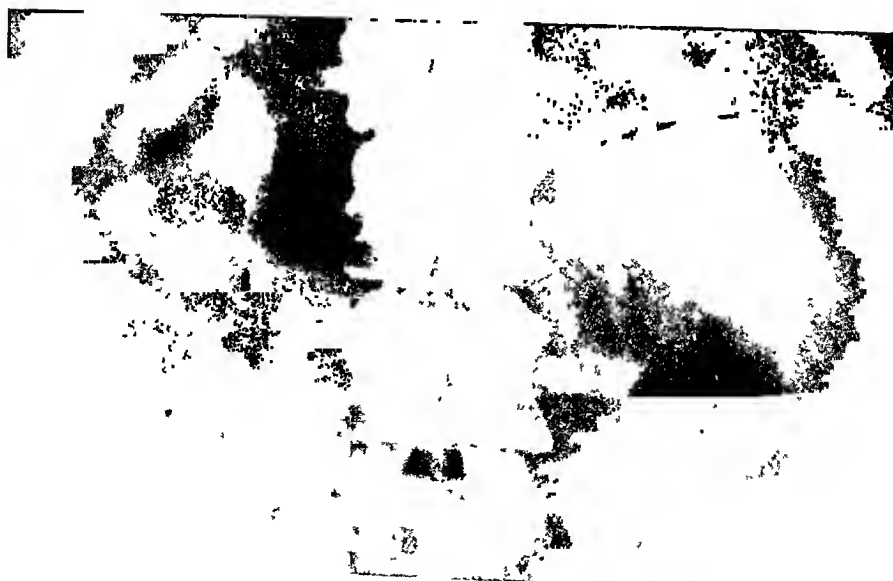
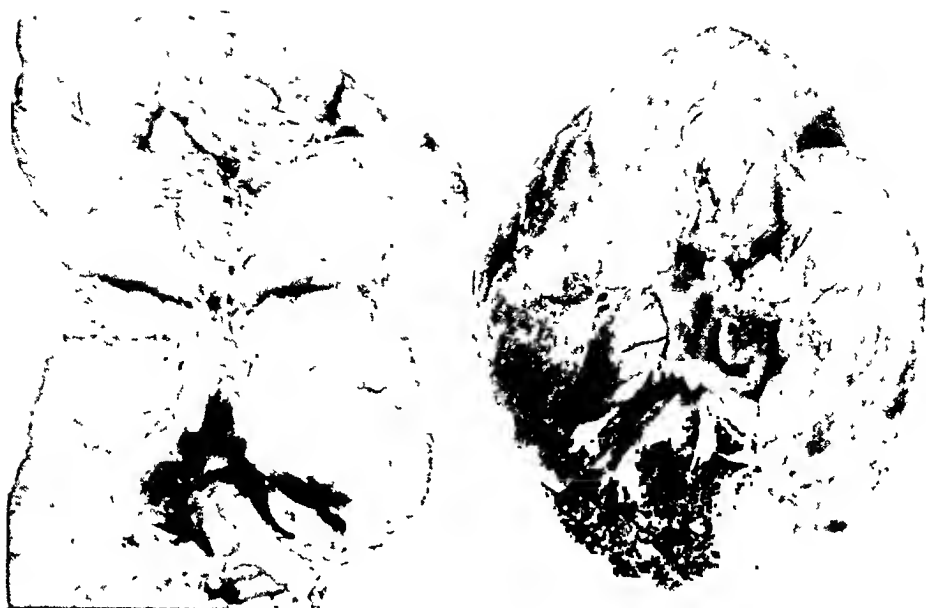


Fig. 13. Case 5. After operation.

SMB: Renal Tuberculosis.



Res. upper pole right kidn.

Res. upper pole left kidn.

Fig 14. Case 5. .



Fig. 15. Case 4.

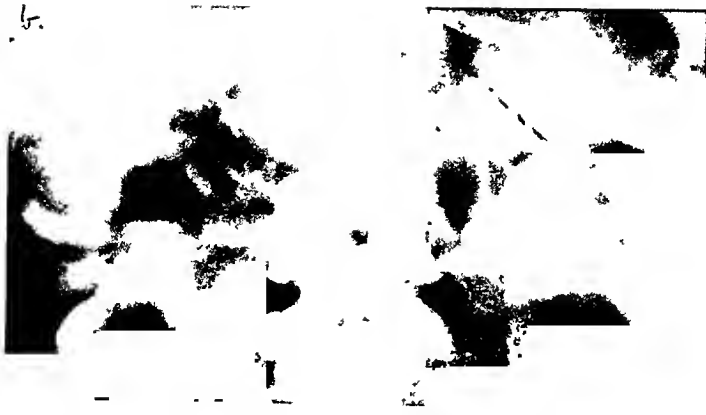


Fig 16. Case 4. After operation I.



Fig. 17. Case 4 After operation II.

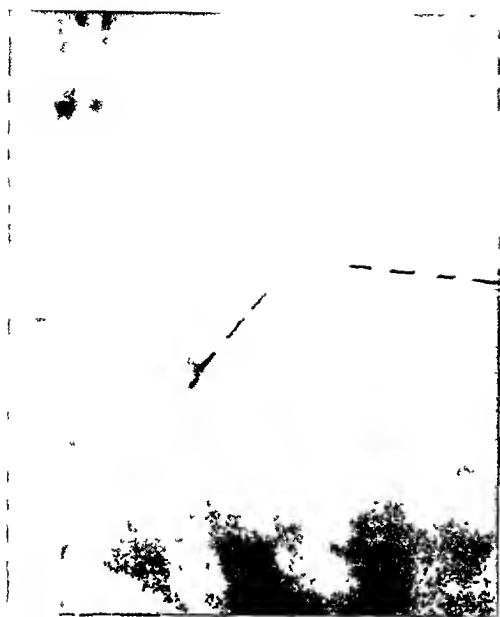


Fig. 18. Case 3 Before operation.



Fig. 19. Case 3. Before operation.



Fig. 20. Case 3. After operation.



Pyonephrosis right.



Resection $\frac{1}{2}$ kidn. left.

Fig. 21. Case 3.



R. side. Resection of upper pole.



L. side. Total nephrectomy.

Fig. 22. Case 9.

SEMB: Renal Tuberculosis.

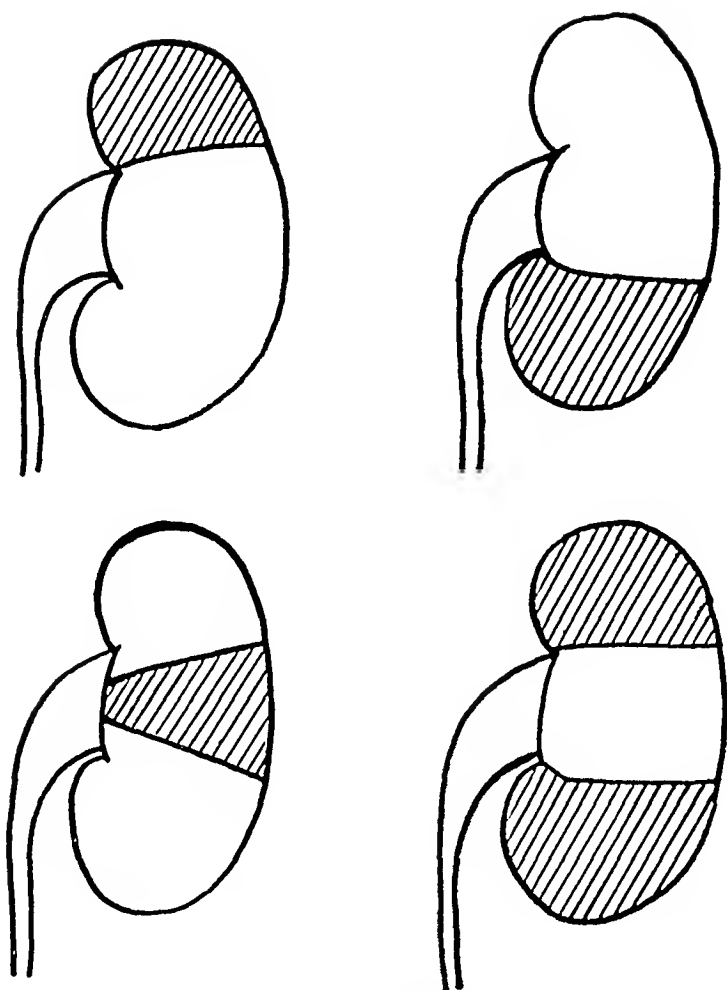


Fig. 7. Types of kidney resections in tuberculosis.

Individual cases:

Case 1. 39-year-old male. Previous thoracoplasty. Unilateral local destruction. 19.1.48. Partial *resection* (upper pole) without streptomycin. Little post-operative reaction. Tb. bacilluria continued a long time but stopped 10 months after operation by use of streptomycin (Fig. 8 and 9).

Case 8. 42-year-old male. Multiple localisation of Tb. Almost complete destruction of both upper and lower groups of calyces in right kidney. 15.12.48. *Resection of both* upper and lower poles right kidney. Post-operative reaction slight, no particular complications. Tb. negative in one test only. General condition excellent (Fig. 10 and 11).

Case 5. 25-year-old female. Previous pleurisy and Pott's disease. Bilateral renal Tb. with bladder infection. Roentgen examination showed destruction in both poles of the left kidney, possibly more in the lower and middle parts. 19.4.48. *Resection of left upper pole.* Moderate

reaction. No complications. 26. 10. 48. *Resection* of right upper pole. Little reaction. Still Tb. positive in urine possibly because of another focus on the left side. General condition good (Fig. 12, 13 and 14).

Case 4. 21-year-old male. Previous pleurisy. Pyuria discovered on conscription. Tb. positive both sides. Roentgen examination (military hospital) foci in both kidneys. 17. 4. 48. *Resection* of right kidney, middle part. 18. 6. 48. Little reaction after streptomycin. *Resection* of left kidney, upper pole. Little reaction. Renal function normal. Blood urea 30 mgms. %. Urea clearance 90 %. Concentration 1024. Cultures negative for Tb. both sides. Roentgen examination no cavities. Total of 234 gm. streptomycin (Fig. 15, 16 and 17).

Case 3. 29-year-old male. Previous pleurisy and pericarditis and Pott's disease. Dysuria. Bilateral renal tubercle. Right-sided pyonephrosis, stenosis of right ureter and Tb. infection of bladder. Left side, local destruction of lower half. Tb. positive R. and L. Renal function depressed. 15. 3. 48. *Resection* of lower half of left kidney without streptomycin. Relatively severe post-operative reaction. Blood urea rose to 185 mgms. % but fell to 60 mgm. after 4 weeks. 6 weeks later treated with Streptomycin and slight wound infection stopped. 18. 10. 48. Right sided *nephrectomy*. Little reaction.

Renal function improving later. Blood urea fell to 46 mgm. %. Maximum concentration 1024.

Senior Physician BLEGEN has done the following clearance tests 1 month after last operation:

Hippuric acid	700 ml/min.	(Normal 2 kidneys 1,200)
Creatinine clearance	76 ml/min.	(Normal 90—100)
Urea clearance	42 ml/min.	(Normal = 75)
Filtration fraction	16.7 %	(Normal figure).

He has surprisingly good renal function, considering that he has only half a kidney. Patient is in good health and has gained quite a lot of weight. Tp. normal E. S. R. 19 (Fig. 18, 19, 20 and 21).

Case 9. 44-year-old male. Previous pleurisy. Bilateral renal Tb. with bladder infection. Left-sided pyonephrosis with total blockage of ureter and no secretion. Right side cavity in upper pole. Lower half normal.

Renal function	Sp. gravity	1006—21
Urea clearance	65 %	59 %
(Fig. 22.)		

12. 1. 49. Left *nephro-ureterectomy*. Removal of a large pyonephrotic kidney. Sp. gravity 1002—23. Urea clearance 74—56 %. 1. 2. 49. *Resection* of R. kidney upper pole without complete clamping of renal pedicle (Fig. 22). Considerable post-operative reaction. Difficult expectation (bronchiectasis). Renal insufficiency. Oliguria for 4 to 5 days, later improving. Blood urea rose to 275 mgm. % on 5th day, thereafter decreasing to normal in 14 days. Out of danger.

Dr. MALM has performed the following examinations in the post-operative period.

Table I.

*Kidney function after partial resection of right kidney
and previous left nephrectomy.*

Re- section	Date 14. 2	Time	Diuresis	Urea- blood	Urea- urine	Urea Clearance	Creat. Clearance
P. O. Day 1	15. 2	Day Night	90 ml 26 "	40 mg % 75 " 93 "	680 mg % 221 "	2.39 ml/m. 0.3 "	0.7 ml/min.
2	16. 2	Day Night	70 " 70 "	119 " 150 "	237 " 328 "	0.3 " 0.5 "	0.5 "
3	17. 2	24 hrs.	185 "	190 "	470 "	0.9 "	—
4	18. 2	"	420	250 "	573 "	1.22 "	—
5	19. 2	"	915	265	928	2.75 - 5.1 % ml, m. st. clearance	
6	20. 2	"	925	275	1205	3.5 - 6.5 " "	
7	21. 2	"	1475	211	1781	9.15 17 " "	14.3 ml
14	7. 3	2 hrs.	100 50	59	1475 1535	32.3 60 " " 22.9 12 " "	

In the presence of *active pulmonary tuberculosis* this should be brought under control before operative treatment is done for the renal disease. A renal operation can damage the lung process and this ought to be avoided if possible. The problem is a little different where there is a pyonephrosis causing considerable toxæmia of the patient. Then it may in some cases be an advantage to the general condition to remove the diseased kidney before the lung operation. An example of the first group was:

Case 6. 28-year-old female. Bilateral pulmonary disease for many years. After failed A. P. in 1945, 1) *Ex. P. on left side*. In 1918 cavity in right lung and simultaneous renal tuberculosis. Selective treatment of both lungs and kidney, first by 2) *thoracoplasty* under streptomycin treatment in two stages. 3 months later 3) *resection of kidney*.

The kidney function plays an important rôle in connection with these operations, both in the immediate post-operative stage and for the patient's life later on.

In the immediate post-operative period an acute renal insufficiency may be fatal. For the future it is important to secure the patient the greatest possible kidney reserve. The operation puts

an extra strain on the renal function and particularly when the kidneys have been diseased beforehand. The situation is in many ways comparable with lung function after a thoracoplasty. Here the mortality has fallen greatly with the introduction of selective operations in small stages.

With the resection of part of a kidney, some renal tissue remains on the operated side, and soon starts to function once more, thus assisting the other kidney. It has been shown that this happens relatively quickly. Urograms taken after, for example, 14 days—3 weeks have shown good secretion by the remaining part of the resected kidney. This may be of importance if the kidney on the other side has been damaged before.

When both kidneys are to be operated on, the best kidney ought, in my opinion, to be operated on first, so that this one is in order when the operation is done on the worst, as it may happen that a large resection or total nephrectomy may be required.

In our series we have operated on 5 bilateral cases in which this has been put into practice. In one case with pyonephrosis on the right side with very poor function and local destruction on the left side, the left side was operated on first with resection of half the kidney (Case 3). The minimal function of the pyonephrosis on the right side helped to maintain renal function during the period immediately after resection of the best kidney. Still greater difficulties were experienced in two cases where there was complete absence of renal function on one side because of ureteral stenosis and pyonephrosis, and at the same time a destructive lesion on the other side (Case 9, Case 13). In one case the pyonephrotic kidney was removed first because it might be supposed to be doing damage by its toxæmia and because it was completely functionless. After nephrectomy, renal function seemed to improve slightly. At the resection of the sole remaining kidney this must alone be responsible for renal function. However, all went well after a few days of oliguria and considerably depressed renal function (see case 9). [The other case (case 13) has recently been operated upon and is improving.] Our biochemists have been of great help to us with these cases. Daily tests have served as guides to the treatment.

For the future function it is important in general to save the patient the largest possible reserve of renal tissue because the kidneys may need this reserve when put under maximum strain. Whether the strain on renal function after removal of much

Table II.
Partial resection of kidney for tuberculosis.

Case no.	Right	Left	OBS. P. O. Months	Bladder		Tb — Urine After Months
				Bef.	After	
1	—	Res.	13	—	—	— 10
2	—	Res.	12	+	—	— 6
3	Exst.	Res.	11	+	—	— 8
4	Res.	Res.	11	+	—	— 4—6
5	Res.	Res.	11	+	+—	+
6	—	Res.	9	+	—	— 3½
7	—	Res.	3	—	—	
8	Res.	—	3	+	?	— 1
9	Res.	Exst.	1	+	?	
10	—	Res.	1	—	—	
11	Res.	—	¼	+	?	
12	—	Res.	½	+		
13	Res.	—	¼	+		
14	—	Res.	¼	+		

¹ Kidney without function.

healthy tissue leads to activation of tuberculous foci, we do not know, but it is possible.

It has been shown experimentally in dogs that they can live with half a kidney; that is one quarter of the normal renal tissue. Two of our cases seem to confirm this as the patients are in the best of health with half a kidney. We may expect that there will be a gradual hypertrophy of the remaining kidney substance as is found experimentally, and roentgen-examination seems to confirm this.

On the final results as regards healing of the tuberculosis by local operation on the kidney, it is too early to give an opinion. The urine is free from bacilli in 5 of our 6 cases with follow-up of

more than 9 months. Follow-up from month to month has shown that bacilli do not disappear at once but 4 to 10 months after resection, in part depending on streptomycin therapy, but also without connection with this.

The follow-up is much too short, and the number of cases too few to draw any certain conclusions.

It is clear that we must attempt to control the bacilli in the urine in the same careful way that we control the sputum in patients after operations for lung disease. Bladder infection has shown a considerable tendency to remission after resection and streptomycin treatment. Whether this will lead to secondary stenosis of the ureter with moderate ureteric infection, we do not know.

The general condition of all completed cases has been considerably better after operation.

The series shows that it has been possible to accomplish a partial resection of a tuberculous kidney (or kidneys) with good immediate results, and to operate on bilateral cases. To what extent this procedure can come to compete with unilateral nephrectomy and medical and drug treatment, it is certainly too soon to give an opinion.

Summarising one may say:

- 1) Renal tuberculosis demands greater interest and systematic study than hitherto, because of its high incidence and often late diagnosis.

- 2) Medical and drug treatment ought to be given much broader scope than before.

- 3) Surgical treatment should be carried on in connection with medical treatment as is done in pulmonary tuberculosis. An attempt ought to be made to carry it out in a more selective manner than has been used up to now.

Summary.

The treatment of renal tuberculosis needs revision. Many cases are overlooked. Medical treatment is incomplete, though it may be improved by streptomycin and other drugs. Surgical treatment has involved the routine use of unilateral nephrectomy. The management of renal tuberculosis should be organised with pulmonary tuberculosis as a pattern. There must be mass efforts

at early diagnosis, increased medical treatment, and individualised selective surgical treatment.

The surgical treatment in our cases has been carried out in a manner analogous with pulmonary tuberculosis. Medical and surgical treatment have been combined. Those cases without evident destruction (shown by urography and pyelography) are treated medically. Cases with local destructive lesions have been treated by local resection of the focus, cases with total destruction by nephrectomy. The author has worked out a technique of partial resection of the kidney. This has been carried out in 14 cases of which 5 had bilateral disease. 16 resections and 2 nephrectomies have been performed. The mortality has been nil. Post-operative urinary fistula, bleeding or spread of the disease has not been observed in any case. At the end of treatment the two patients left with one half of one kidney are in good general health.

It is too early to give an opinion on the final results as regards bacilluria. Of 6 cases observed for more than 9 months, 5 are abacillary.

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Pyelorenal Cysts.

By

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M. D.

In November, 1948, a woman, aged 38, was admitted at the Surgical Clinic of Serafimerlasarettet, with a twenty years long history of renal disease for which she until then had been treated in the central community hospital of her home town. Her mother had died in pulmonary tuberculosis, when the patient was 15 years old. In this connection she was exposed to t.b. infection. She had, however, showed no signs of active tuberculösis.

The patient's renal affection appeared for the first time in 1928, when she was 18, with shivers, temperature, increased micturition, pains in the right renal region and albuminuria. Subsequently, bladder troubles. Two years later uncharacteristic symptoms and intermittent pains in the left side, increasing in frequency during the following year. Five years after her first attack, in 1933, recurrence of pains on the right side, together with violent shivers, with temperature peaks up to 41.8 C, tenderness and defense, anteriorly and posteriorly, above the right renal area. Vomited. Condition affected and dry. Small quantities of urine. Non-protein nitrogen 106 mg %. The urinary sediment contained plenty of white blood corpuscles and *Bact. coli*.

Roentgen-examination showed a considerably enlarged renal shadow on the right side, 8 cm broad, 16 cm long, a calcification, twice the size of a brown bean, at the site of the right ureter in the pelvis, and, in addition, calcifications on both sides of the lumbar vertebral column, the size of a walnut. The latter were interpreted as calcified mesenteric glands. The left kidney was judged normal. On account of the patient's condition and the rise in non-protein nitrogen, no urography was performed. Ureterolithotomy + nephrectomy were performed. The ureter had the width of a thumb. The kidney was large, described as a big pyonephrotic sac. The changes were considered too pronounced to

render future function possible. The after-course uneventful, though pyuria with *Bact. coli* remained.

Four months after the operation coli-infected urine was discharged from the left ureter with an increased number of white blood corpuscles. Irrigation of the bladder and various antiseptics applied to the urinary tract proved of no avail. Simultaneous retrograde pyelography was stated to show normal configuration of renal pelvis and calices. The calcium shadows were still interpreted as originating from mesenteric glands.

Two and a half years later, in 1936, again an onset of pains on the left side, with otherwise uncharacteristic symptoms. The infection in the left kidney remained, continuing to be resistant to therapy. Nor in this instance were the calcifications supposed to affect the urinary tract on the left side. Only 2 years later, *i. e.* in 1938, arose for the first time a suspicion that they were localized within the kidney. They were also stated to have changed appearance since 1933. See Fig. 1, the oldest retained picture. In 1940, deterioration in connection with pregnancy necessitated a legal abortion.

In 1942, a new acute onset with pains on the left side. Generally affected condition, temperature 39 C. Albuminuria, but no bacteria ascertainable in the urine on this occasion. Roentgen-examination at compression disclosed distinguishable concretions, displaceable in relation to the lower renal pole. The earlier diagnosis was readopted, *viz.*, mesenteric gland calcifications, situated outside the renal shadow. During the following months, daily slight pains above left renal region, and, later, new intense, left-sided attacks of typical nephralgic pains with spontaneous passage of stones, followed by anuria, temperature, rise in non-protein nitrogen and strongly affected general condition. New roentgen-examination including intravenous urography between the attacks revealed that the calcifications had again changed shape, and a calculus situated at the site of ureter in the pelvis (Fig. 2). For the second time the calcifications were suspected to lie in the renal pole or close to it. After twelve hours' anuria a disintegrating stone was obtained at ureteral catheterization. Clouded urine drained through the inserted catheter, but shortly afterwards anuria again set in. Renewed cystoscopy, 10 hours later, disclosed marked swelling of the ureteral orifice. The ureteral bar showed a club-like swelling. Catheter could not be inserted. The edge of the mucous membrane at the orifice was so pronouncedly swollen that endoscopic scissors could not grasp it. One blade was pressed against the orifice and the distal part of the ureter was slit up. After this a brownish mass spurted out from the ureter, followed by a cascade of cloudy urine. The anuria was overcome. Temperature and non-protein nitrogen fell rapidly.

During the subsequent years on and off symptoms of cystitis, occasionally ache over the left kidney. Suspected that stones sometimes were spontaneously expelled. In the summer of 1947 again pregnant. Roentgen-examination and urography in July showed that the calcium-dense shadows on the left side had *further diminished in number*. For the first time they were now stated to be distinctly localized to one

group of calices. In addition, there was a suspicion of intrarenal calcifications (Fig. 3). Also now the pregnancy was considered to involve serious risk and, for this reason, legal abortion + sterilization were performed.

She was afterwards free from symptoms till October 25th, 1948, when a severe left-sided nephralgic attack again appeared, accompanied by a rise in temperature to 39° C. Urinary secretion diminished. Urography now disclosed a row of stones in the lower part of the ureter. The collection of calculi in the lower renal pole had been still further reduced since the previous examination (Figs. 4 and 5). After spasmolytics the ureteral stones were spontaneously delivered. So far, the patient had on all occasions been treated at the central community hospital. After her discharge, she still felt slight acute pains on the left side and often rather chilly. Was subfebrile, had not seldom headache, nausea and vomiting fits. Applied at Scrafimerlasarettet, admitted on November 20th, 1948.

The general examination disclosed nothing noteworthy. General condition was good. Blood: Hb 83 %. Red blood corpuscles 4.3 mill., white 4,500. Hematocrit 30 %. Serum albumin 6.1 %. Blood calcium 11.2 mg %. Blood phosphorus 3.4 mg %. Blood chloride 315 mg %. NaCl in plasma 520 mg %. CO₂ binding capacity 42 volume %. Non-protein nitrogen 22 mg %. Urinalysis: Heller neg., Almén neg. 8—10 white, 1—2 red blood corpuscles, 1—2 renal epithelial cells per field of vision, plenty of Gram-negative rods. Culture: Bact. coli, resistant to sulfa and penicillin, sensitive to streptomycin.

Roentgen-examination on November 18th 1948 (ERIK LINDGREN): "The right kidney missing. The left kidney somewhat enlarged, situated in the usual place. In the lower part of the left kidney a great many calcifications. At changed position, a group of calcifications has moved, while a couple of minor calcifications has remained still. *Urography*: Renal pelvis and calices well filled. From the lowest calix a rounded cavity, about 2 cm in diameter, fills through a narrow neck about 1 cm long. It lies in the medio-inferior part of the kidney, extending out to about two mm from the external contour of the kidney. In this cavity the movable calcifications lie. They, accordingly constitute calculi in the cavity. In the wall of the cavity (between the external contour and the contrast-filled cavity) are some small calcifications, *i. e.* those that remain unmoved when the patient changes posture. The ureter is a trifle wide, but no obstruction to passage exists (Fig. 6).

A comparison with earlier pictures discloses that a cyst was to be found in the same place in 1938, which at that time was larger than now, containing a greater number of calcifications. In 1942 no considerable change had occurred since 1938, apart from the fact that stones were then to be seen also in the ureter. Since then, therefore, the cyst has diminished in size, while the calcifications have been reduced in number."

The diagnosis was fixed as pyelorenal cyst with stones, but it was considered impossible from the roentgen picture to dis-

tinguish this from a solitary renal cyst of a different kind with calcifications. A certain tendency towards self-healing was apparently present, seeing that the cyst had successively diminished and the calcifications become fewer. No prospects of a complete evacuation of the cyst were, however, supposed to exist. The cyst must be assumed to constitute the focus of the continuous infection of the urinary tract for the past 20 years. This infection, as well as each discharge of a stone implied a serious risk of irreversible damage to the patient's only remaining kidney. For these reasons, operation was decided on. The purpose was to extirpate the cyst, if possible, or, otherwise, to resect the lower renal pole.

Extirpation of the cyst in the lower left renal pole was performed by the author on November 24th, 1948. Left-sided lumbar incision. No perinephritis. In the lower renal pole a shrivelled, fibrous cystic formation, hardly the size of a fig, containing calculi, was palpated. Apart from medially and caudally, it was on all sides encompassed by renal tissue. The surface of the kidney somewhat lobulated. Otherwise it seemed normal. The cystic formation was situated within the kidney's own capsule. It could be separated from the normal renal tissue partly by knife, partly by blunt dissection. All the time profuse bleeding from up to slate-pencil-wide vessels. Gradually, the some millimeters wide communication with the renal pelvis could be isolated and divided close to the pelvis. Attempt at invagination of the proximal part of the passage failed. For this reason, only the stump was ligated. After ligation of the vessels, a medially and caudally open crateriform cavity appeared in the lower renal pole. The walls of the latter could not be brought together by through-going sutures. A pedieled flap from m. psoas was turned in and fixed by sutures to the walls of the cavity. After the operation the surface of the kidney did not disclose any changes in colour, indicative of any disturbances in the circulation. An X-ray film was inserted into the wound and exposed in order to preclude that stones during the manipulation, had passed from the cyst to the urinary tract. No calcium-dense shadows were visible. Drainage of the wound cavity by a fine rubber tube. Otherwise suture. Immediately after the operation, an amount of 200 ml of faintly sanguinolent urine was evacuated from the bladder.

Patho-anatomic diagnosis (FALCONER): "*Macroscopy*: solitary cyst, the size of a fig., with a firm, smooth wall. No definite stalk or neck-part ascertainable in the fixed specimen. In the cyst about a dozen brown-yellowish, hard, slightly faceted stones, approximately the size of the head of a pin.

Microscopy: the wall of the cyst resembles rather a changed kidney. Thus, innermost, an epithelial layer occurs, partly bulged or marked by small papillae, with two strata, the exterior rather flattened, the interior one with high cells. Thus, the type corresponds in these places

to those of the epithelium of the urinary tract. Within other areas, the epithelium is multi-stratified, with 3—5 layers, assuming the nature of a uncornified squamous epithelium. Below the epithelium follows a layer of collagenous tissue with more or less sharply delimited groups of lymphocytes, some of which displaying reaction centres. In some places, particularly in one where the tissue gently protrudes into a bulge as a small papilla, minor groups of smooth musculature appear to be stored in the connective tissue.

Outside the epithelium and the connective tissue, groups of mostly ectatic rounded lumina follow, deposited in connective tissue, containing a colloidal, moderately eosinophil mass, next surrounded by a simple, partly flattened, cubical epithelium. Round this, the connective tissue collects in concentric layers as a membrana propria. Partly on a level with these ectatic lumina, partly outside them, groups of mostly obliterated and hyalinized glomeruli were found, whose structures here and there were clearly distinguishable. Outermost the formation is limited by some strata of collagenous, densely stratified connective tissue.

The vessels are many and their walls thickened and hyalinized practically throughout. In the connective tissue between the ectatic lumina and the destroyed glomeruli a diffuse, inconsiderable infiltration of lymphocytes. Foci of fairly large calcium granules.

Patho-anatomic diagnosis: renal cyst, formed like a hydronephrosis + calculi.

From the above description it is obvious that the cyst reveals structures of a mucous membrane of renal pelvis (with metaplasia of the epithelium), as well as of degenerated renal parenchyma.

The latter shows dilated renal and urinary canals in which the particular kinds of epithelium have lost their characteristics, while the secretion appears to have stagnated and thickened. The glomeruli are severely changed, though, evidently, fully developed. A moderate inflammatory reaction occurs.

With regard to these histological characteristics and the presence of calculi it seems most likely that this represents an originally normally constructed part of a kidney, strongly hydronephrotically and atrophically changed." Fig. 7.

After-course: inconsiderable reaction. 1,200 ml of Dextran Ph and 1,000 ml of glucose intravenously administered. During the second 24 hour-period a rather profuse amount of urine passed into the dressing. However, after another 24 hours this ceased. The drainage tube removed on the fifth day. After this only slight suppuration for a few days.

Since the urine also after the operation disclosed a moderate pyuria with sulfa- and penicillin-resistant coli strain, on the eighth day 3 gm of streptomycin were applied for two days and reduced to 2 gm daily for an additional 5 days. 24 hours after the application of the streptomycin the urine was sterile and remained so. All traces of albumin, which had been found almost constantly for 20 years, had completely disappeared, as well as the pyuria. 16 days after the operation intra-

venous urography revealed good excretion, ordinary shape and width of the lowest group of calices, as well as absence of calcium-dense shadows on the left side (Fig. 8).

18 days after the operation the patient was discharged as healed.

The case offers an interest from several points of view.

The possibilities of a diagnosis have been exclusively roentgenological. Because of the fact that the earliest pictures are no longer available, it is impossible to say whether the communication to the cavity in the lower renal pole existed as early as at the retrograde pyelography in 1933. Such a communication was no doubt to be found in 1938 but was disregarded and, consequently the diagnosis from the earliest plain picture, viz. extrarenal glandular calcification with stone-free kidney, was maintained for several years. A temporary occlusion during a stone-passage from the cyst seems to have occurred in September 1942, when the urine was sterile in connection with simultaneous pains, high temperature and generally affected condition. Possibly the first diagnosis has also influenced the procedure on the occasion of the first operation. The description of the specimens does not justify any conclusions as to whether it had been possible to save the right kidney, had it been known that also the left kidney was infected and carried stones. Had a correct diagnosis been available at the subsequent examinations, new prospects would have offered themselves and the story of the patient might have turned out differently.

Once a diagnosis of a cyst containing stones in the lower renal pole, with a free communication to the renal pelvis, had been determined on, it remained to ascertain the nature of the process. Tuberculosis could be entirely eliminated. No grounds existed for the occurrence of the bilateral stone-formation from other reasons than a coli infection. Apart from the cyst, the calices in the upper half of the kidney disclosed conspicuously long infundibular parts with a clumsy distal distention without any noticeable papillary excavations, as at a beginning hydro-calix. Such a shape of the renal pelvis is well known as a cause of resistant infections of the urinary tract, as well as of the formation of stones (ÖSTLING, 1934, WINSBURY-WHITE, 1939, BENNETT, 1941, CHALKLEY & SUTTON, 1943, RUDSTRÖM, 1948).

Solitary cystic formations with an open communication of the renal pelvis are rare. On the basis of 10 cases, KROGIUS, 1904, classified them as a separate group. In his opinion, they origina-

ted congenitally from some part of the renal pelvis. This conception is contradicted by later findings and investigations, as indeed by the cases cited by KROGIUS himself. They very likely arise during the latter part of life in four ways that differ in principle, as follows: either through perforation into the renal pelvis from a renal or pararenal cyst, through rupture of the kidney, through ectopy of a part of the kidney or through atrophy of renal parenchyma round a single calix with a subsequent cystic dilatation. In support of this contention may be quoted that, according to CHALKLEY & SUTTON (1943), only 11 cases of solitary renal cyst in children had been described in the literature since 1893. In not a single one of these cases was, however, any communication with the renal pelvis to be found. Among 471 congenital renal and ureteral anomalies. SMITH and ORKIN (1945) did not discover a single case of such a cyst. The number of such cysts, ascertained in adults, probably amounts to about fifty, including the so-called pyelorenal cysts or cases of hydro-calicosis.

Solitary cysts in, or adjoining, the kidney occur, in round numbers, in 1 instance of 200 renal affections submitted to operation (ISRAEL, 1/217, SCHMIEDEN, 11/2100). As a rule, they consist of a simple, thin-walled cystic formation, the inner side being coated with a simple cubical epithelium without any components other than connective tissue and minor vessels in the wall. The contents are clear, poor in constituent elements. Mostly, they are localized to the lower renal pole and may attain a considerable size. Their origin has not been incontrovertibly elucidated. Usually, they appear to injure the kidney only through a secondary dislocation of kidney or ureter with subsequent disorders to circulation and discharge. Roentgenologic or clinical differential diagnosis as against tumor or cyst of some other kind cannot be determined even after puncture and contrast injection. There are descriptions of cases when only a microscopic examination has disclosed a thin plate of cancer or of hypernephroma within a limited area of the wall of the cyst (HEPLER 1930). Treatment with puncture and sclerosing injections must therefore be rejected. This also for the reason that, in the course of such treatment, a stormy reaction has set in, whereby a later conservative surgical intervention, saving the kidney, would not be performable.

In other instances, the serous cysts consist of a lymphogenous cyst in the renal hilus (HENTHORNE 1938), usually originating

from inflammatory processes or a collection of fluid between the surface of the kidney and its capsula propria, viz. so-called hydrocele renis (KROGIUS 1930). Also dermoid cysts and aneurysmal sacs in the immediate proximity of the renal pelvis have been observed (HEPLER 1930).

In these five cystic forms, the occurrence of a communication with the renal pelvis through atrophy by pressure is conceivable, though to the authors knowledge no such case has been indisputably ascertained. On the other hand, the occurrence of such a communication between cystic adenocarcinomas, sarcomas and hypernephromas is known (KROGIUS 1904, MAGOUN 1939). A communication between the renal pelvis and the cyst has also been observed in so-called blood cysts or pseudohydronephroses (CRABTREE 1935, JOHNSON and SMITH 1941), which originate from liquified perirenal hematomas after traumatic ruptures of the kidney. In that instance the communication consists of a persistent renal rupture. The probably first reported case of renal cyst communicating with the renal pelvis, viz. that described by CAESAR HAWKINS, published in 1833, can be suspected of having been of this origin.

A few years later, 1837 and 1841, RAYER reported the probably first published case of renal cyst with an open communication with the renal pelvis, which had to be interpreted genetically by means of the, in principle, fourth mechanism of origin, viz. dilatation of a calix or group of calices with simultaneous destruction of its renal parenchyma.

Cystic formations originating in this manner, have been given various names, such as pyelogenous cysts (QUINBY and BRIGHT 1935), hydrocalicosis (WATKINS 1939) calyceal diverticulum (PRATHER 1941), calyectasis (ENGEL 1947). Considering the essential part that destruction and dilatation of the renal tissue are likely to play in their origination, pyelorenal cyst seems to be a more adequate term and, in addition, it does not signify anything as to their contents. Apart from the forementioned authors, minor series and isolated cases with such formations have in recent years been published by ÖSTLING (1934), LJUNGGREN (1936), WINSBURY-WHITE (1939), HYAMS and KENYON (1941), NATVIG (1941), LERNER and GAZIN (1946) and RUDSTRÖM (1941 and 1948). There appears to be reason to question whether the formations discussed by ASK-UPMARK (1939), which he terms recesses of the renal pelvis, are not genetically similar. ASK-

UPMARK himself makes this suggestion though he regards the formations as congenital, originating "von einer zytotropischen Diskoordination zwischen dem Ureteralen Zystem und dem Blastemapparat". He is of the opinion that a congenital origin is proved by the absence of glomeruli or remnants of glomeruli in the cystic wall, while, on the other hand, canals containing colloid have most often been found, even in such numbers as to make the tissue resemble a struma colloides.

It is difficult to arrive at any conclusions regarding the origin of the cysts even from a microscopic examination. The occurrence of transitional or metaplastic squamous epithelium, as well as of smooth musculature in the cystic wall has been cited in support of a pyelogenous origin. Absence of such epithelium or of remnants of glomeruli does not appear to exclude the possibility of an etiologically combined simultaneous origination from renal pelvis and kidney, nor does the absence of a communication between the cyst and renal pelvis do so. In HYAM's and KENYON's case the origin and later closure of the cysts could be followed roentgenologically and afterwards verified patho-anatomically.

Genuine renal pelvis diverticula or cysts, originating in dis-united ureteral ramifications have not been definitely established. In one of the cases reported by KROGIUS the cyst may, however, have arisen from an aberrant ureteral branch with the supplementary ectopic, renal part belonging to it and consequently be an example of the third possibility mentioned above. In another of the reported cases, the cyst communicating with the renal pelvis and the renal papilla opening into it would, on the other hand, rather be supposed to have originated from a renal rupture and, consequently, be referable to the so-called pseudo-hydronephroses.

As will be seen from RUDSTRÖM's paper (1948), various authors have regarded the hydrocalix as resulting from a calyceal stricture on an inflammatory basis, in which changes of the type of pyelitis cystica have been noted (ÖSTLING 1934), or from obturating stones, but cases occur without infection (BENNETT 1941) or stone (WATKINS 1939 and others) or either (BENEVENTI 1943). For this reason, in WATKINS' opinion, circular spasm in the infundibular part of the calix with a relative obstruction constitutes the cause. BENEVENTI's (1943) classification of the cysts in hydrocalix, calyceal diverticula, renal cysts and localized obliterating pyelonephritis has a more theoretical than real basis.



Fig. 3. Case 1. 1947 X-ray plate after urography.



Fig. 2. Case 1. 1942 plain X-ray plate.

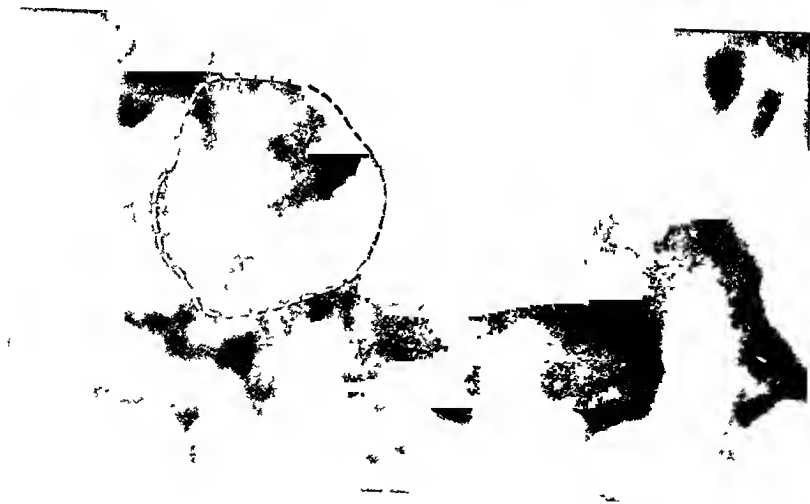


Fig. 1. Case 1. 1938 X-ray plate after urography.

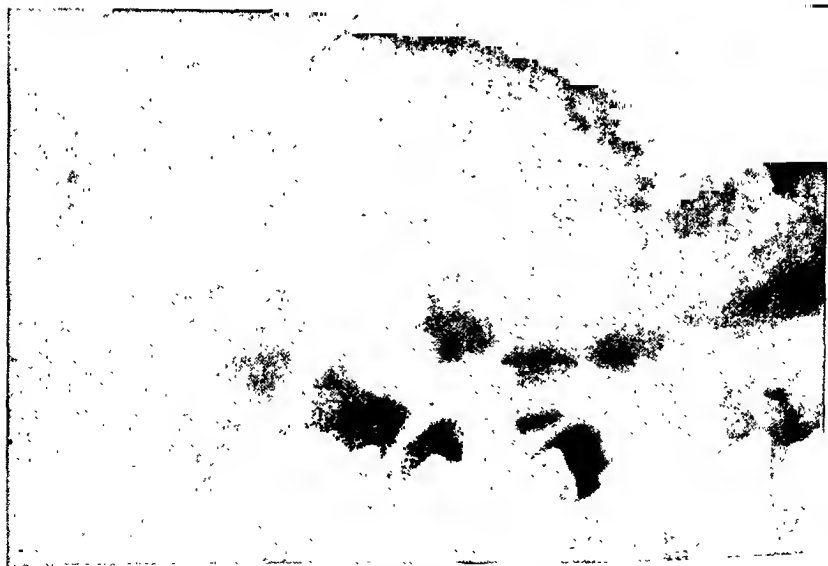


Fig. 4. 1948 X-ray plate after urography.

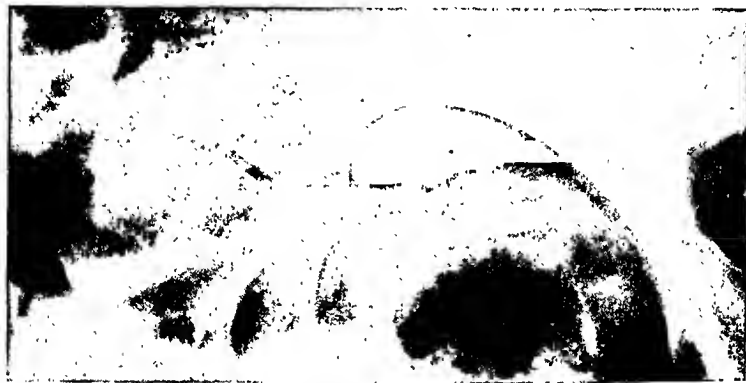


Fig. 5. Case 1. 1948 X-ray plate after urography.

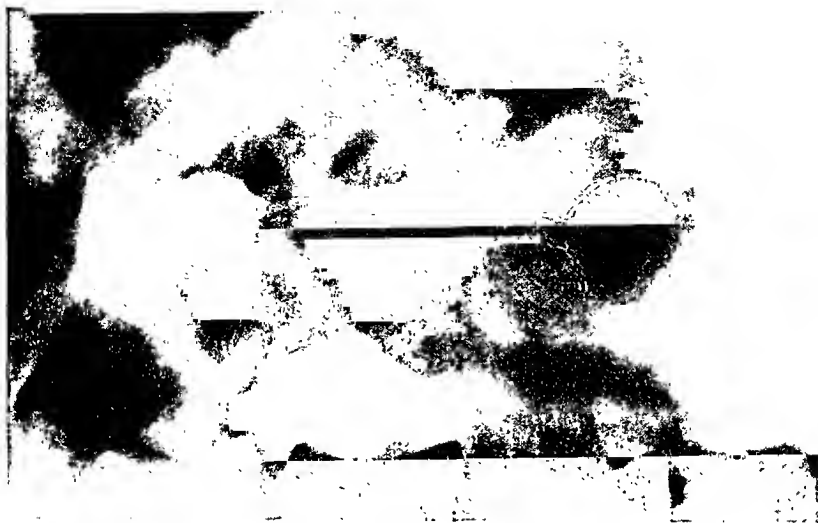


Fig. 6. Case 1. 1948 X-ray plate after urography immediately before operation.

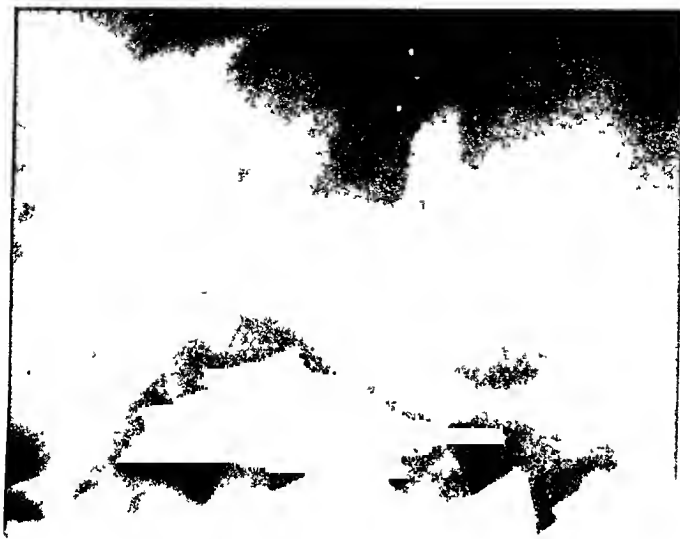


Fig. 8. Case 1. 1948 X-ray plate after urography 16 days after operation.



Fig. 7. Case 1. Photomicrograph (140 \times) of pyelorenal cyst.



Fig 9 Case 2 X-ray plate after urography before severe pyelitis during pregnancy



Fig 10 Case 2 X-ray plate after urography after delivery

Of particular interest from the point of view of the origin are, on the other hand. HINMAN's and HEPLER's (1926) investigations.

In their own view, their experiments are elucidative with regard to the etiology of all solitary renal cysts, a contention which may have to be accepted with reserve. All the same, their experiments are very instructive as to the occurrence of pyelorenal cysts. They found that the hydronephrotic development in kidneys of rabbits occurred considerably more rapidly and assumed much more extreme forms when the obstruction of the urinary tract was combined with a reduced or abolished arterial blood supply. By means of combining a ureteral ligature with ligation of branches of the renal artery, local sac-like distentions, with a narrow communicating aperture to the renal pelvis, were in a short time obtained. When the discharge from a renal papilla was occluded through fulguration and the artery was ligated to the corresponding pyramid, a solitary renal cyst without any communication with the renal pelvis arose. The histologic picture of the walls of the experimental cysts entirely conformed to those observed in clinical cases. Also the macroscopic conditions disclosed complete conformity to the described cases. The investigators assume that vascular lesions, endarteritis, aneurysm, infarcts, pressure of tumors etc., through local arterial circulation disturbances, will cause a likewise local malacia in the kidney, and that afterwards, in such a place, a cyst-like distention will be rapidly established, particularly when a simultaneous obstruction of the urination occurs.

Local arterial disturbance of the circulation, obstruction of the urinary flow, stone formation and infection appear to be co-operative factors in the origination of pyelorenal cysts. With regard to the infection, in all cases that the author has been able to find in the literature, except one (HYAM and KENYON 1941), it has been due to *Bact. coli*.

An anomalous shape of the renal pelvis, with long, narrow calices, involving a tendency to temporary or permanent stenoses, has been regarded as being predisposing. Such calices are to be found here and there in the kidney of the above described surgical case. In several places, also clumsy, cyst-like calices are noticed distally to these narrow calix infundibulae. Also in another case, which the author has observed several such calices are to be seen, but the small pyelorenal cyst which, to judge from the roentgen

pictures, developed did not localize itself to any of these calices but to a primarily, quite normally formed calix.

In this case a common cystopyelitis with *Bact. coli* appeared in a woman, aged 21, with a previously healthy kidney. Apart from isolated, long, narrow calices, especially on the left side, urography disclosed nothing abnormal. The lowest calix on the right side showed an entirely normal shape (Fig. 9). Half a year later, about half-way through her first pregnancy, a new cystopyelitis appeared with abdominal pains on the right side, violent changes in temperature, but slight pyuria. Culture still showed *Bact. coli*. When the pyelitis had abated, and the patient had been delivered of the child, another urogram was taken. This showed a club-shaped cystic distention of the lower calix on the right side. At the same time, the papillary excavation had totally disappeared, while the breadth of the parenchyma belonging to it had considerably diminished (Fig. 10). Control examinations during the subsequent 10-year-period have disclosed an unchanged picture. The case has been regarded as a first phase of development of a pyelorenal cyst.

The localization within the kidney of the pyelorenal cysts has varied. Usually, they are to be found in the upper or lower pole. They appear to be somewhat more common in women.

In the symptomatology, grinding pains in the abdomen and back have predominated, alternating with typically nephralgic pains, together with general symptoms, often of a dyspeptic nature in connection with headache, and, finally, symptoms of infection of the urinary tract and, in several cases, stone formation with passage of stones. For long periods the patients may be free from symptoms. A completely spontaneous evacuation of the calculi from a cyst, communicating with the renal pelvis, has been observed by RUDSTRÖM (1941). Also in the case related above, the majority of the stones escaped spontaneously. Simultaneously, the cyst diminished in size.

The diagnosis entirely depends on the roentgen-examination. At any rate, the latter, together with the clinical finding, will probably always render a differential diagnosis as against tuberculous caverns possible, while a differentiation as against renal abscesses with perforation into the renal pelvis and renal cysts of some other origin will not be performable. As stated above, a genetic differentiation as against other forms of cysts may prove difficult or impossible even after a histologic examination.

In cases deficient in symptoms the therapy has been exclusively expectant, while, in cases with stones, persistent infection or at the suspicion of a tumor, surgery has been resorted to. As RUD-

STRÖM (1948) states, the kidney has, in this connection, been sacrificed, most often, it will seem, needlessly. In the majority of cases the cyst could, probably, have been excised and removed by means of renal resection, as was done in ENGEL's and RUDSTRÖM's cases, as well as in the present one. In ENGEL's 9 cases of conservative intervention the final result proved permanently favourable after 5—12 years.

Summary.

Two cases of pyelorenal cysts are described, one in the only remaining kidney with multiple calculi and infection in the cyst for more than 20 years, resulting in a condition imperilling life, with anuria in the course of an earlier spontaneous passage of stones. Health returned, after excising the cyst and streptomycin treatment. In both instances, infection with *Bact. coli* occurred.

The etiology of the pyelorenal cysts is discussed together with other solitary renal cysts communicating with the renal pelvis. They are supposed to be acquired. Their symptomatology, diagnosis and therapy are touched upon. The therapy should, according to the symptoms, be conservative or conservatively surgical. Nephrectomy should not be necessary.

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Surgical Intervention in Recurrent and in "Radioresistant" Cancer of the Uterine Cervix.

By

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At the Radiumhemmet cases of cancer of the uterine cervix are treated with radium and Roentgen radiation, the radium being considered the most important. Surgery is used only in the event of failure of radiotherapy in either of the two following instances:

- (a) local recurrence following primary healing by radiotherapy,
- (b) failure of response to radiotherapy, *i. e.* the so-called radio-resistant cases.

A case is classified as an instance of local recurrence if a fresh local lesion develops after freedom from evidence of disease has been demonstrated by repeated examinations for six or more months. Prior to first treatment some cases of this type appear early some advanced.

The following two types of cases are classified as "radioresistant":

1. Small primary lesions which remain macroscopically unchanged following a complete course of irradiation.
2. More extensive growths which do not disappear even though markedly diminishing in size and extent following irradiation.

Most of the so-called radioresistant cases which are subjected to surgery are prior to first treatment interpreted as early.

Since there is no definite dividing line between the two groups it is occasionally difficult to determine whether a case should be

classified in the category of local recurrence or "radioresistant". This is particularly true if only one or two months have elapsed in the period between "freedom from evidence of the disease" and "local recurrence", or if no follow up examination has been done for several months during that period.

In classifying the cases the original size and extent of the growth should also be considered. It is reasonable to presume "freedom from evidence of the disease" in a case where an originally large and extensive growth almost completely disappears leaving a small suspicious remnant that remains unchanged for a long period of time. On the other hand, it is likewise reasonable to register a case as "radioresistant" where the conditions are reverse, *i. e.* an originally small, circumscribed growth and a short time of observation.

At the Radiumhemmet 136 cases of a total of 6,302 cases of primary cervical cancer have been submitted to hysterectomy or to an exploratory laparotomy for one of these two reasons during the period 1914 to June 1947.

(a) Operation because of a Local Recurrence.

Each patient having completed her radiotherapeutic treatment for cancer of the cervix, is examined regularly at the Radiumhemmet. During the first years following treatment the examination is usually repeated monthly or bimonthly. If a patient once clinically free from evidence of the disease, develops a local recurrence, hysterectomy is considered strongly indicated. Operation should be performed without delay because there is great risk of rapid progression.

Prior to operation the possibility of radical removal of the growth should be carefully estimated by bimanual examination and cystoscopy. In spite of careful examination cases are frequently encountered in which at laparotomy radical removal is found to be impossible because of lymph-node metastases, involvement of the parametrium or involvement of the bladder. This will be discussed more fully later.

Further, it should be observed that in a number of cases great difficulties are encountered in distinguishing between local recurrence and late radium reaction. When in doubt we prefer to wait or to treat by electro-fulguration. A microscopic examination

of a biopsy is often of value but will frequently provide no definite information.

Group (a) includes only cases in which a radical operation was considered feasible. The following are excluded: Patients considered inoperable because of the spread of the growth or because of complicating disease; patients treated by electro-fulguration of the recurrence. These two categories form a much larger group than those submitted to hysterectomy.

The cases operated upon because of local recurrence number 69, *i. e.* about half the total number of operated cases and 1.1 per cent of the total number of cases treated. In eight patients the operative intervention was restricted to an exploratory laparotomy because of lymph-node metastases.

Fourteen of the sixty-nine patients operated upon have been observed for less than five years after operation. Sixteen of the remaining fifty-five were alive and free from evidence of the disease at the end of the five year period, *i. e.* a relative 5-year cure rate of 29.1 per cent.

Four patients died following operation, *i. e.* a primary mortality of 5.8 per cent; one patient died from intercurrent disease a year and a half after operation, and six are alive without evidence of the disease and observed for less than five years; forty-two died from cancer, including the eight patients submitted to an exploratory laparotomy. Of these forty-two patients twenty-one died within a year following operation, *i. e.* 50.0 per cent.

The interval between the completion of radiotherapeutic treatment and the operation, and the distribution of patients alive without evidence of the disease five years after operation was as follows:

Interval of $\frac{1}{2}$ to 1 year — 36 cases — 9 five-year survivals.

Interval of 1 to 4 years — 17 cases — 7 five-year survivals.

Interval of 10 to 12 years — 2 cases — 0 five-year survivals.

At laparotomy it was noticed that in twenty-one of the sixty-nine cases (30.6 per cent), operated on because of local recurrence, the cancer had extended outside the uterus. Of these one patient was alive and free from evidence of the disease five years after operation; she died from cancer in the seventh year. One is alive and free from evidence of the disease more than four years after operation. Four patients died at operation. Of the remaining fifteen patients, eight survived the operation for more than one year (53.3 per cent).

To the group of local recurrences are referred ten cases in which there was no visible recurrence on inspection of the vagina and the portio. The patients were submitted to hysterectomy because of a sudden and considerable enlargement of the uterus indicating a recurrence situated somewhere within the uterus.

Six of the cases were originally endocervical growths; adenocarcinoma in four cases and squamous cell carcinoma in two cases. They were operated upon $\frac{1}{2}$, 1, 2, $2\frac{1}{2}$, 4, and 11 years after irradiation. Microscopic examination of the removed specimen showed involvement of the entire endometrium in three cases, of the cervical endometrium in one case, and of the upper area of the corpus endometrium in two cases.

Three cases were originally large cauliflower adenocarcinomas on the portio and one was a squamous cell cancer showing a crater in the right vault. In the three first mentioned cases the recurrence was confined to the endometrium of the corpus and not extending below the internal os.

Three of the seven cases of adenocarcinoma were alive and free from evidence of the disease five years after operation.

A rapid increase in size of the uterus, caused by fluid indicates a recurrence. An intrauterine recurrence is frequently observed in corpus cancer. It is occasionally noticed in endocervical adenocarcinoma and is rare in squamous cell cancer of the portio.

(b) Operation because of "Radioresistance".

As mentioned above, this series includes (1) early cases in which there was little or no difference in size and extent of the growth during and after radiotherapy and (2) cases in which a continuous regression was observed at first but in which the tumour, instead of disappearing, began to grow anew. No cases are included which, on account of the spread of the growth and the patient's general condition, were considered as bad operative risks. Consequently, most cases are of Stage I and II.

Close control of the individual patient during and after treatment and a fair share of experience is required in order to define a case as "radioresistant", and to judge the degree of operability.

The Radiumhemmet series of "radioresistant" cases submitted to laparotomy number 67, *i. e.* about half of the total number of operated cases and 1.1 per cent of the total number of cases treated. In four cases the surgical intervention was restricted to exploration because of pelvic lymph-node metastases.

Fifty-eight of the sixty-seven patients have been observed for at least five years following operation. Seven of these were

alive and free from evidence of the disease at the end of the five year period, *i. e.* a 5-year cure rate of 12.1 per cent.

Fourteen patients died following operation, *i. e.* a primary surgical mortality of 20.8 per cent; two are alive without evidence of the disease and observed for less than five years; forty-four patients died from cancer within 5 years after operation, the four exploratory laparotomies included. Of these forty-four patients, thirty-four (77.3 per cent) died within a year following operation.

With access to the great improvements offered by modern surgery it might have been possible to avoid the high incidence of primary mortality. It should, however, be observed that in ten of the fourteen patients, the cancer had spread outside the uterus. The operation was technically difficult and may be characterized as one desperate last effort. The ten patients would have died from cancer probably within a year and a reduced primary mortality would not have altered the 5-year cure rate.

The interval between the completed radiotherapy and the operation, and the distribution of the patients alive without evidence of the disease five years after operation was as follows:

Interval less than 1 month — 6 cases — 0 five-year survival.

Interval less than 2 months — 10 cases — 1 five-year survival.

Interval less than 3-6 months — 42 cases — 6 five-year survivals.

At laparotomy it was noticed that the cancer had extended outside the uterus in thirty (44.7 per cent) of the sixty-seven cases. None of these patients survived the 5-year period. Ten died at operation; of the remaining twenty patients five survived the operation for more than a year (25.0 per cent).

Discussion.

A comparison between the two groups of cases operated upon, (a) the local recurrences and (b) the "radioresistant" cases, shows the following differences:

- (1) The 5-year cure rate is 29.1 per cent in group (a) and 12.1 per cent in group (b).
- (2) At the time of operation the cancer had spread outside the uterus in 30.6 per cent of the group (a) cases and in 44.7 per cent of those of group (b).

- (3) Of the patient dying from cancer within five years following operation 50.0 per cent of the group (a) cases and 77.3 per cent of the group (b) cases died within a year.
- (4) The 5-year cure rate tends to improve parallel to an increase in length of the interval between radiotherapy and operation (see p.p. 491 and 493).

From the above observations we may conclude that hysterectomy in case of local recurrence following radiotherapy is a justifiable procedure; it may result in a thirty per cent 5-year cure rate and the operative death-rate is low (5.8 per cent). A radical operation in cases with lymph-node metastases or with involvement of the parametrium or the bladder offers apparently little chance of cure and a palliative effect is noticeable in a limited number of cases only.

Surgical intervention in "radioresistant" cases seems to be a dangerous procedure with a high primary mortality (20.9 per cent), and to be of minor effect in respect of cure and palliation. It should be restricted to cases in which, at laparotomy, no cancer outside the uterus is noted.

The mentioned differences in the clinical behaviour between the local recurrences and the "radioresistant" cases may deserve further attention.

The term radioresistant was adopted in the early days of radiotherapy in order to characterize special types of cancer in which radiotherapy would fail even if applied at an apparently early stage. Among the different types of "radioresistant" cases of cervical cancer were mentioned the adenocarcinoma and the undifferentiated cancer. Further efforts to define, clinically and microscopically, the "radioresistant" cases have failed. It is still not possible to distinguish by present means special groups of cases which because of "radioresistance" are unsuitable to radiotherapy.

Since there is no other practicable way, it is customary to estimate the prognosis in cases of cervical cancer by the anatomoclinical extent of the growth. However, any experienced clinician is aware of the fact that the prognosis is not determined only by the extent of the growth. He knows that cases of apparently identical extent may vary considerable as to the degree of malignancy. For example, within Stage I there are some cases which will long remain local and some which will spread rapidly. In a large sample of Stage I cases different degrees of malignancy

nancy will be represented. They form a continuous series characterized by a gradually increasing degree of malignancy. At the beginning of the series are the least malignant cases which after treatment will be cured and will remain cured. Then follows the more malignant in which a primary cure will be obtained but which will sooner or later develop a local recurrence. Next in the series are the cases which will never be primarily cured but in which treatment will be followed by a more or less pronounced improvement. Finally, the series terminates with the cases in which the cancer will continuously progress in spite of treatment, *i. e.* the extremely malignant, incurable cases.

It is conceivable that Stage I is composed of a high proportion of less malignant cases and a relatively small number of extremely malignant ones, and that conditions are reversed in Stage III for instance. This way of looking at the problem would explain the failure of therapy in a relatively small number of Stage I cases and the varying cure rates noticeable when comparing small series of cases. It would also explain why treatment succeeds in a small number of patients seeking treatment in an advanced stage, and the moderate cure rate in Stages II and III.

All the differences mentioned above (p.p. 493 and 494) favour the presumption that the cases which we have registered as local recurrences are less malignant than are those registered as "radio-resistant". Such a presumption would explain why the local recurrences show (1) a higher cure rate, (2) a smaller proportion of cases spreading outside the uterus, and (3) a longer period of survival, and why (4) the result improves parallel to an increase in length of the interval between radiotherapy and operation.

The samples of patients are too small for definite conclusions to be drawn. However, should our observations hold true, it would mean that the cases which appear to be "radioresistant" are in fact of the more malignant type and that the reason for failure of radiotherapy should be attributed to a pronounced malignancy and not to "radioresistance".

The varying degree of malignancy should be kept in mind when, for the purpose of publicity, the phrase is used that cancer of the cervix can be cured in nearly a hundred per cent of the cases if treated at an early stage; it should be remembered when drawing conclusions as to the value of different methods of treatment from a comparison of the results obtained in a small series of cases, and when discussing the recent claim for an extended

use of surgery either as a primary intervention or combined with preoperative irradiation. The claim is based on the presumption that by surgery it would be possible to save a number of cases which cannot be cured by radiotherapy, and to improve the final result of therapy. Should, however, the cases in which radiotherapy fails, coincide with a more pronounced malignancy, the cases will be cured by no method of treatment, whether radiological, surgical, or combined. It will seem as if the cases which on clinical observation appear to be "radioresistant" are in fact incurable.

Summary.

Report on two series of cases operated upon following radiotherapy: (1) sixty-nine cases of local recurrence and (2) sixty-seven "radioresistant" cases. The observations made at operation and the difference in the results obtained within the two series indicate that the so called radioresistant cases are of a more malignant character than are the cases which after a primary cure develop a local recurrence. Attention is drawn to the possibility of "radioresistance" being synonymous to incurability whatever the method of treatment used.

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Pain in the Hand Caused by Localized Thrombosis in the Radial Artery.

Report of a case.

By

LARS-ERIK GELIN.

Posttraumatic thrombosis in the vessels of the hand have been described by VON ROSEN in 1934, in the ulnar artery, and by SCHÄR, who in 1935 published two cases, one in the radial and one in the ulnar artery. A case with similar symptoms has been reported by SNYDER and SNYDER in 1938 and this showed thrombosis in the deep veins of the hand.

A patient with thrombosis in the radial artery has recently been treated here. Compared with the above mentioned cases he presents a typical clinical picture, and a report of the case might be of some interest.

Case Report.

A 35-year-old previously healthy metal-worker presents himself with continuously increasing pain of five weeks duration in the first left intermetacarpal space dorsally. He himself does not suspect trauma to be the cause of his troubles, but he remembers having hit an iron-frame with the hand a few weeks before the pain started and having had slight pain for two days. He describes his pain as being initially a dull ache of successively increasing intensity and subsequently changing to pain on movements. About a week before consulting us he also began to experience neuralgiform pain radiating from the first intermetacarpal space towards the thumb and index finger and towards the wrist and lower arm. The pain is finally of such intensity as to render his going to sleep difficult and make it impossible for him

to continue his work. He feels no increased sensitivity to cold. Relief is obtained by gripping the lower arm steadily with the healthy hand so that venous congestion is effectuated and also by keeping the hand immobilized in the position of rest.

Upon his first visit nothing particular was to be found on the general examination. The skin appeared normal on both hands and no difference

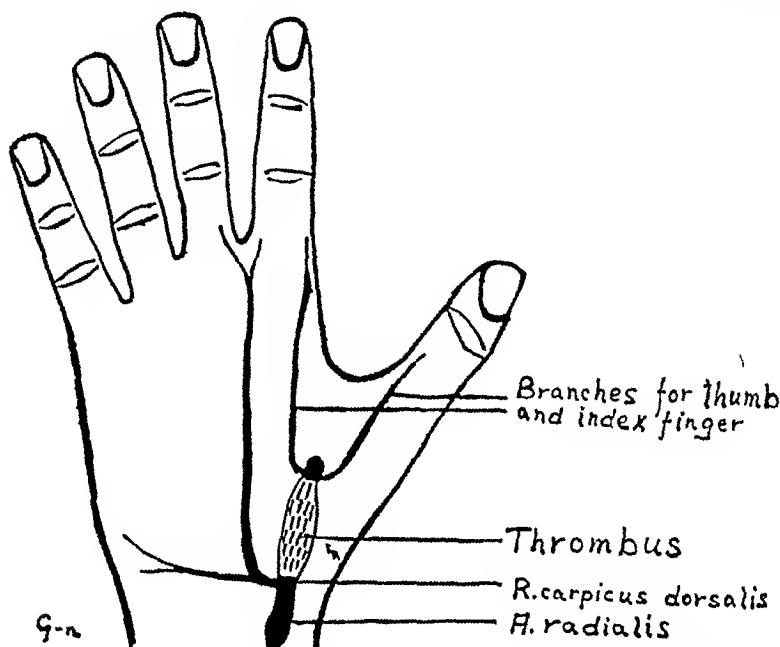


Fig. 1. Shows the radial artery and its branches and the thrombus.

in surface temperature between the two hands could be palpated. The soft parts in the first left intermetacarpal space were slightly swollen. A distinctly painful spot was found on palpation deeply near the head of the first metacarpal bone, where a small induration could just be discovered. The strength of the grip between thumb and index finger was decreased. Roentgenologically the hand was normal.

As no definite diagnosis could be arrived at, the hand and lower arm were immobilized, in spite of which severe pain persisted. Local infiltration with procain resulted in five hours' freedom from pain. As the pain increased in intensity we finally advised surgical exploration suspecting a ganglion, a neurinoma, an implantation cyst or a glomus tumour.

Two months after the pain had started a conduction anesthesia of the radial nerve was applied and an incision was made dorsally in the first intermetacarpal space. The branches of the radial nerve were exposed and found to be normal. The long extensor tendon of the thumb was held aside, thereby exposing the radial artery which showed to be fusiformly swollen, thickened and of blue colour within 2.5 cm. In this part of the artery no pulsations could be felt, but the dorsal carpal branch of the radial artery and the main stem proximally to the origin

of this branch were pulsating normally. Distally to the diseased portion of the artery two branches were given off to the thumb and index finger, and these branches were non-pulsating, contracted and white-glistening. The diseased portion of the radial artery was ligated and removed. Shortly after the removal of the diseased arterial segment pulsations could be seen in the previously contracted and bloodless branches to the thumb and index finger. The incision was sutured.

The structure removed was an arterial segment of 2.5 cm's length containing a hard thrombus. Anatomico-pathological description (BERING): "Arterial vessel with thrombus in advanced stage of organization. In a cross-section from the middle of the removed structure, where evidently the thrombus is oldest and most organized, the vessel-wall is attenuated and reduced with dissolved muscular coat, reactionary fibrotic changes and haemosiderosis. These changes diminish successively in both directions from the central section and soon disappear. The thrombus remains, but becomes smaller and more recent. No changes beside the above-mentioned can be found in the vessel-wall. No eosinophils are seen. Owing to the circumscribed character of the changes in the vessel-wall and the absence of signs of other vascular diseases the process is considered as being of traumatic origin."

The wound healed by first intention. Two weeks after the operation the patient was free from pain and returned to work.

Discussion.

Etiology: The previously reported cases of similar kind are probably caused by a single trauma. In this case too, the traumatic origin seems probable in spite of the patient's not having himself stated trauma to be the cause of his troubles.

Besides having a traumatic origin, thrombotic processes in arteries can be the result of diseases in the artery wall and its immediate neighbourhood. Of special interest in this connection seems to be the unspecific type of arteriitis described by THORSÉN and DIRS in 1947, a circumscribed arteriitis with severe pain, clinically appearing as foot-weakness, brachialgia, back pain or headache. This type of arteriitis is most commonly met with in the temporal artery, where it has been described by among others SJÖVALL and WINBLAD in 1944.

The pathological process can as a rule be reconstructed from the histological picture: trauma with damage to the arterial wall and an endothelial defect, thrombus formation on the damaged spot and secondary thrombosis, later organization and recanalization.

The absence of inflammatory cells supports the differential diagnosis vascular disease — traumatic injury.

Clinical picture: The clinical picture has been uniform in all the reported cases. In connection with the injury the patient experiences pain from the contusion corresponding to the severity of the trauma; as a rule the injury is slight and the immediate pain is negligible. After a free interval of 2—4 weeks increasing pain is felt and subsequently severe neuralgiform pain makes the normal function of the hand impossible.

On examination a localized tenderness and sometimes a palpable mass is felt. A typical feature is that in the reported cases a ganglion has been the attempted preoperative diagnosis.

Patho-physiology: In LERICHE's great work on the physiology of arterial occlusion the importance of the reflex spasm is pointed out. According to LERICHE there is in the arterial wall a mechanism for the control of the collateral circulation. A constant stimulus to an artery, as from a thrombus, causes contraction in the collaterals and ischaemia in the tissues supplied from the affected vessels.

Remarkable in this case is that immediately after the removal of the diseased artery the collaterals to the branches for thumb and index finger began to function so that it was possible to watch the blood-filling in the formerly contracted, bloodless branches, which ought to be of a special interest in connection with the opinion of LERICHE.

Both in VON ROSEN's and SCHÄR's cases direct contact were found between the diseased artery and small branches of nerves, which they connected with the neuralgiform pain. In our case also, there was typical neuralgiform pain without the radial nerve being in contact or even in the neighbourhood of the diseased artery. It seems more possible that an ischaemical stimulus of the ends of the nerves is the cause of the neuralgiform pain.

Therapy and prognosis: In the above-mentioned cases removal of the diseased artery has been carried out. Freedom from pain and capacity for work has been attained 2—3 weeks after the operation. As palliative treatment blocking of the stellate ganglion can be tried. Removal of the artery gives an exact diagnosis and freedom from pain immediately and effectively.

Conclusion: Severe pain in the hand with localized tenderness often indicates exploration of the region from a diagnostical and therapeutical point of view. Possibly cases of localized thrombosis in the arteries of the hand are not so rare as their presence in the literature seems to indicate.

Summary.

A case with severe pain in the hand caused by thrombosis in the radial artery is described and compared with three earlier described cases of thrombosis in the arteries of the hand. Etiology, clinical picture, patho-physiology and treatment are discussed.

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(Head: Professor OLLE HULTÉN, M. D.)

The Treatment of Post-Traumatic, Habitual Dislocation of the Ulna in the Distal Radio-Ulnar Joint.

By

OLLE HULTÉN, M. D.

Habitual dislocation of the ulna is not a particularly common complaint. It is, nevertheless, of some interest since its treatment involves considerable difficulties and it is accompanied by appreciable invalidity. The cases reported in the following illustrate these statements.

Case 1. The patient was a woman, born in 1926. At the age of 12 she suffered a fracture of the right forearm of a fairly mild nature. It was treated in the Out-Patients' Department with a plaster splint and healed in a good position. Two years later (1940) she had a fall from a bicycle and landed on her right hand. There was no fracture on this occasion but a dislocation of the distal radio-ulnar joint. The ulna was completely loose and could be displaced 1—1½ cm in relation to the radius. The displacement was particularly pronounced in the volar direction. She had considerable pain particularly on pronation and supination. After treatment with various kinds of fixation bandages for 1½ years without any improvement it was decided in 1942 to attempt a plastic operation with a strip of fascia. The strip, which was taken from the fascia lata, was drawn in a loop round the ulna and attached to the volar and dorsal aspects of the radius. The arm was immobilized for some time afterwards, but when it was freed there was no improvement and dislocation of the ulna still occurred.

The patient then attended an orthopaedic clinic on repeated occasions and was finally fitted with a leather splint in order to press the ulna into position. The splint gradually caused a bursa over the head of the ulna. The bursa became infected and the patient was admitted to hospital in 1942 for its extirpation. Her condition did not improve.

Many different methods, even X-ray treatment, were attempted in order to relieve the pain but proved ineffective. The pain in the wrist incapacitated her so that she was unable to work and even to write. A year later (1943) she again attended our hospital. There was then considerable tenderness to pressure on the ulnar aspect of the wrist and pain radiating upwards in the forearm and downwards along the little finger. The force of the grip of the hand, measured with a dynamometer, was 3 on the right side and 22 on the left. All movements, particularly pronation and supination, caused pain. Movement was restricted in several directions. When, however, the head of the ulna was pressed into position the extent of movement was the same in the right and the left wrist. An arthrodesis operation on the wrist and a pseudo-arthritis on the ulna — the same operation as described in the following case — was considered. The operation was nevertheless postponed since it was felt that she was too young for such an intervention — only 17 years old — and that it would be better to wait. She then moved from Uppsala. Two years later she came to the hospital in Halmstad with the same complaints as previously. She herself wished for an operation but it was not performed. The writer then lost trace of her. During the five years in which it was possible to follow her progress no improvement occurred.

Case 2. The patient was a man, born in 1920. At the age of 16 he suffered a fracture of the left forearm of the same kind as the foregoing patient. The fracture healed in a good position after being in a plaster splint for $2\frac{1}{2}$ months.

In 1941 — five years after the fracture — he was knocked down by a bicycle and struck his left arm on the ground thus causing dislocation of the ulna. Since then he had been having trouble with the left wrist, which was particularly troublesome since he was left-handed. The ulna could be displaced 1 cm in a dorso-volar direction in relation to the radius. There was also considerable tenderness on pressure over the radio-ulnar joint and the styloid process of the ulna. Pronation and supination were inhibited and the remaining movements were restricted with the exception of volar flexion which was the same as in the healthy hand.

In this case, after six months' ineffective treatment with a bandage, reefing of the joint capsule and of the inter-articular disc was performed (1941). At operation it was found that the radio-ulnar joint was unusually spacious and had a large thin disc that appeared to be torn from its attachment to the styloid process of the ulna. After fixation for about two months, the patient returned to work, which consisted of lacquering with a fairly heavy sprayer which he manipulated with his left hand.

The severe pain nevertheless continued and even disturbed the patient's sleep. His wrist felt unsafe. After six years (1947) he returned to hospital and asked for "the hand to be made immobile". We considered that an arthrodesis between the radius and the ulna would cause him too much inconvenience, particularly in view of his youth. We therefore decided to maintain pronation and supination by making

an arthrodesis in the radio-ulnar joint and at the same time a pseudoarthrosis somewhat higher up on the ulna. This operation was performed in February 1947. The writer then resected about one centimeter of the ulna and used this piece of bone as a bridge in the radio-ulnar joint. The wrist was then placed in a plaster cast for six months. After this time the arthrodesis was firm and the head of the ulna fixed to the radius and no displacement was possible (fig. 1). Owing to the pseudoarthrosis, movement is now satisfactory, the same in the right and the left wrist although the strength is less in the left hand.

The results of the operation are not, however, satisfactory in every respect. The patient states that the greatest advantage is that the pain in the wrist, which previously was very troublesome, has disappeared. He finds it difficult, however, to hold the heavy lacquer sprayer and often hits his forearm at the site of the arthrodesis. It feels "uncomfortable" at this site "crackles as if hard bread were being crushed".

It is in practice extremely difficult to create anything of the same functional quality as the triangular disc. This is very ingeniously formed since its triangular shape prevents displacement both in a dorsal and in a volar direction. Fig. 2 shows the chief injury, *i. e.* the rupture of the disc which on the drawing is shown torn from the radius. In the case on which the writer operated the tear appeared to have taken place at the styloid process. Since the disc can not be repaired, attempts have been made to replace it in more or less ingenious ways by placing around the ulna a strip of fascia which is then attached to the radius.

Fig. 3 shows such a strip graft where a loop has been drawn around the ulna and through a channel bored in the radius, the strip being attached to the radial aspect of the radius.

BUNNELL uses *both* a strip of fascia in a loop around the ulna *and* a strip of tendon from the tendon to the flexor carpi ulnaris, intended to form a collateral ligament between the pisiform bone and the styloid process of the ulna, *and* a small strip of fascia to maintain the extensor carpi ulnaris in position. He uses this procedure since in his opinion part of the discomfort is due to the extensor tendon gliding backwards and forwards over the head of the ulna. Such complicated strip grafts are, nevertheless, often more effective in theory than in practice.

The writer found in his study of the literature that the operation described in the foregoing, *i. e.* arthrodesis and pseudoarthrosis, was already suggested by SAUVÉ and KAPANDIJ in 1936. The only difference is that these authors used a screw to make an arthro-

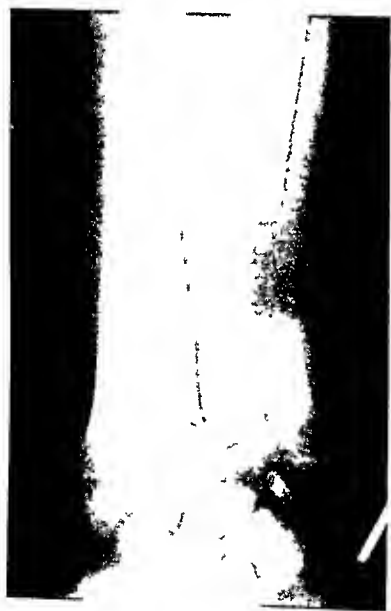


Fig. 1. Arthrodesis of the radio-ulnar joint with a bone graft and pseudoarthrosis on the shaft of the ulna.



Fig. 3. Stabilization of the ulna with a strip of fascia.

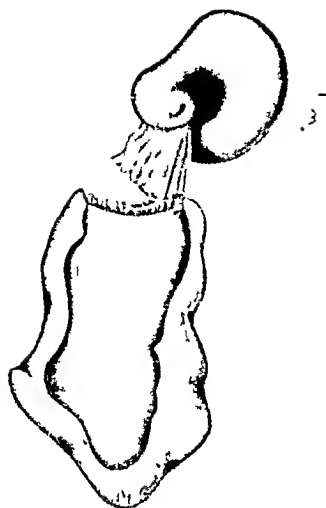


Fig. 2. Dislocation of the ulna with rupture of the intra-articular disc (after ELLISOX).

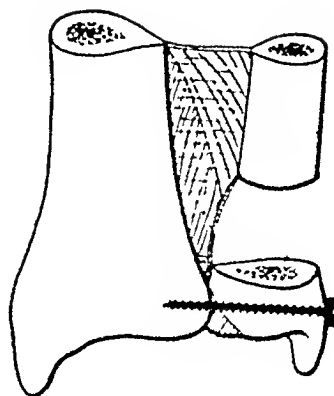


Fig. 4. Sauvé's operation (arthrodesis and pseudoarthrosis).



Fig. 5. (Case 3.) Compound dislocation of the ulna and fracture of the radius.

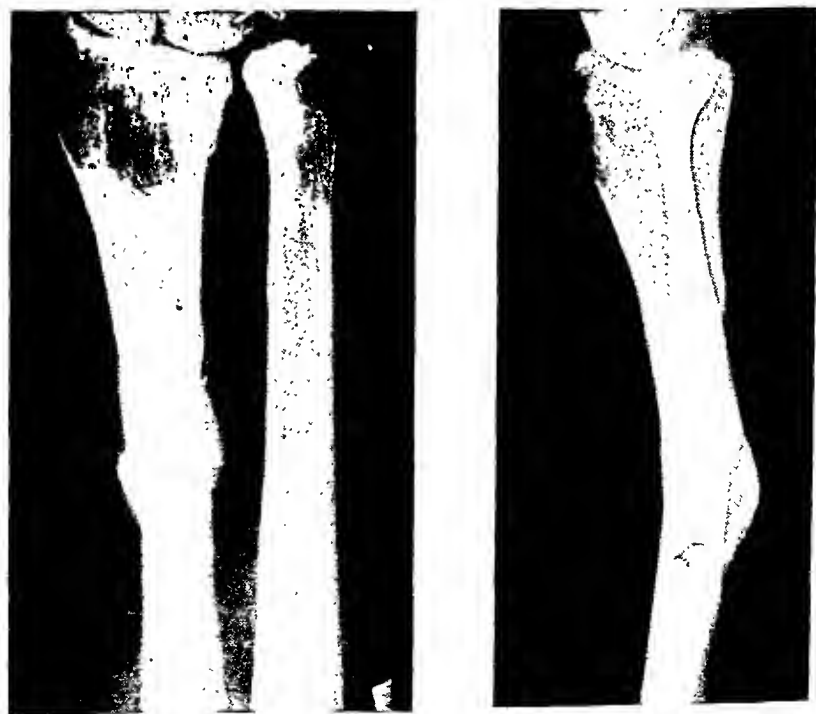


Fig. 6. Case 3 two years later.

desis between the radius and the ulna whereas the writer used a bridge of bone. Fig. 4 is taken from the publication of SAUVÉ and KAPANDIJ.

When one both sees and reads about the mediocre results obtained by means of various operations, one wonders whether the patient was not right when he suggested immobilization of the joint between the ulna and the radius. In the writer's opinion this is presumably the most advantageous for individuals engaged in simple heavy manual labour. This opinion is supported by Case 3, of which an X-ray picture is seen in fig. 5.

Case 3. The patient was a 31-year-old farmer, who suffered a compound dislocation of the ulna and fracture of the radius. The head of the ulna protruded through the skin and was covered by dirt, giving rise to infection in the radio-ulnar joint. Both the fracture and the dislocation nevertheless healed in a good position (v. fig. 6) although there was stiffness in the radio-ulnar joint and inhibition of pronation and supination. The patient can do his farming, has no pain and only finds certain turns of the hand more difficult.

When dealing with individuals engaged in lighter work that demands a greater degree of movement, *e. g.* office work, it is more suitable to maintain the movability in the radio-ulnar joint. It is particularly in young people that one is reluctant to bring about a restriction of movement. Conservative treatment with leather splints, etc. is scarcely to be recommended. In the case described in the foregoing, in any event, such a splint even gave rise to a bursa over the head of the ulna. If it is desired to maintain pronation and supination, a strip graft according to Bunnell's method or arthrodesis and pseudo-arthritis on the lines of Sauvé's operation are those that should be considered.

Summary.

On the basis of three cases of dislocation of the ulna in the distal radio-ulnar joint the writer discusses the most suitable therapeutic method. He concludes that an arthrodesis with inhibition of pronation and supination is to be preferred for individuals engaged in heavy manual labour. For persons doing lighter work a strip graft according to Bunnell's method or a pseudo-arthritis on the lines of Sauvé's operation are preferable since these interventions preserve the capacity for pronation and supination.

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An Operative Method for Dislocation of the Acromioclavicular Joint.

By

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Dislocations and subluxations in the acromioclavicular joint are generally the result of a crash injury. They probably occur as a result of the victim trying to break a fall with the hand extended forward and upward, thus causing the scapula to be pressed backward and downward via the humerus, at the same time as the clavicle is held in place by the neck muscles. Or the mechanism may also be that the blow meets the articular head of the humerus directly under the same circumstances. The injury is most commonly observed in airmen, football players and skiers. It is one of the problem children of surgery, satisfactory anatomic results being difficult of attainment, due to the fact that the scapula is drawn downward by the weight of the arm at the same time as the clavicular neck muscles tend to pull the clavicle upward.

A distinction is usually made between subluxation, in which the acromioclavicular ligament has ruptured, and total dislocation, in which the ligament attachment to the coracoid process is torn also. In the former case, the dislocation is slight; in the latter case it is considerable, the articular surfaces of the clavicle and the acromion no longer being in contact with one another. (Fig. 1.)

Subluxation generally responds well to conservative treatment with some form of fixation aimed at elevating the scapula via the humerus, at the same time as the clavicle is pressed down.

Even though the anatomic result is not always perfect, the functional result is generally fully satisfactory. The period of fixation is at least three weeks. From a practical point of view, it is important that the pressure actually is placed on the clavicle, *i. e.* far enough medially, which experience tells us is not always the case.

True dislocation is more difficult to treat conservatively. Only very slight slipping of the bandage is required to produce another dislocation. WATSON-JONES (Fractures and Bone Injuries, Edinburgh 1946) therefore recommends strengthening the bandage by adding a layer of tightly applied adhesive tape every second or third day. He states that fixation should be maintained for at least five weeks.

The method of keeping the patient in bed on his back with the arm elevated just above the horizontal plane and immediately in front of the vertical plane of the body also requires a long period of fixation (3 to 6 weeks) and does not give dependable end results.

A large number of operative methods have been described. It is the poor anatomic result and the long period of fixation of the conservative methods that have led to experiments with surgical approaches.

There are four main types of operative methods:

- 1) simple suturing of the acromioclavicular ligament with wire or other strong suture material,
- 2) fixation of the clavicle to the acromion with a metal plate and screws,
- 3) fixation in the longitudinal axis of the clavicle with a nail introduced through the acromion,
- 4) fixation of the clavicle to the coracoid process with wire of screws.

The simple suturing method practically always fails because the sutures cut through the tissue. The same is true of fixation with plates of the Lane or Lambotte types. Under the weight of the arm, the screws are loosened, the plate twists, and dislocation again occurs. Fixation in the longitudinal axis with a Kirchner nail or shorter metal nails was recently recommended by PAIS in Bologna (Rev. Orthop. 33, 68; 1947). He left the nail in place for about four weeks, after which he removed it and instituted exercises for about two weeks. No recurrences were noted in 17 cases treated in this way. Other workers state that fixation should



Fig. 1.



Fig. 2.

be maintained for about two months. There is a risk of the nail breaking and of infection. Two cases of the nail passing into the lung have been described (MAZET, Jour. Bone and Joint Surg. 25, 477; 1943).

Fixation of the clavicle to the coracoid process was widely used in the Royal Air Force for war injuries. The standard method was to insert a stainless metal screw from the border-line area between the middle and outer thirds of the clavicle into the coracoid process, thereby relieving the dislocation and achieving firm fixation without damaging the acromioclavicular joint. The period of fixation was two to three weeks. The results were reported to be good, but no figures are available.

BERGH of Sahlgrenska Sjukhuset in Gothenburg published (Nord. Med. 25: 11; 1945) six cases in which the clavicle was fixed to the coracoid process with wire. The results were good, despite the fact that the wire held in only one of the six cases. Apparently it did not break until healing had advanced to the point where its support was no longer required. The arm was kept in fixation for only a few days.

I have tried to achieve fixation by suturing the capsule (*i. e.* the acromioclavicular ligament) or by passing a double loop of wire through the clavicle out on to its articular surface, finally knotting it on the upper aspect of the acromion. The results were not satisfactory. In addition, the risk of secondary joint changes with this latter method is rather great, even if the wire is removed after a month or so has passed.

The last case to come under my care I handled in another way. I bored two vertical holes in the clavicle about 1.5 cm. from its outer end. Through these holes I passed a wire, the ends of which were drawn, with the help of a pricker with an eye at its point, out under the acromion about two centimeters apart, after which they were twisted together (Figs. 1 and 2). Reduction occurred automatically and the fixation seemed firm. The arm was kept in fixation for three weeks, which probably was unnecessarily long. Mobility and strength were regained rapidly, and the patient was able to return to his work five weeks after the operation. Follow-up examination six months after the operation revealed him to be free from signs and symptoms, and the roentgenograms showed that the position was still excellent and that the wire still held. Later on, the wire was found to have broken,

but the anatomical and functional result remained unchanged. The outer, twisted part of the wire was removed.

The foregoing method gives firm fixation in the exact position, is technically simple and spares the joint. It thus has approximately the same advantages as those said to distinguish the coracoclavicular transfixation. Which of the two methods is preferable, however, can only be decided on the basis of a large series of comparable material.

Summary.

Following a brief summary of the usual methods of treating subluxations and dislocations of the acromioclavicular joint, the author describes a method of reduction and fixation in this type of injury, as follows: A double loop of wire is threaded through the clavicle medial to the joint and then drawn out to the external aspect of the acromion, where the ends are spliced. The results of this treatment have been good.

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Über Luxatio habitualis cubiti posterior.

Von

STEN von STAPELMOHR.

Luxation im Ellbogen, die seit HIPPOKRATES, AMBROISE PARÉ bis zu MALGAIGNE klassische Luxation, kommt in 18.6 % von allen Luxationen vor. Die Luxation nach hinten ist von Ellbogenluxation die gewöhnlichste. SOMMER berechnet sie im Jahre 1929 zu 72.5 % von allen in diesem Gelenk. Oft sind diese Luxationen kompliziert mit Frakturen der Epikondylen, des Proc. coronoides oder des Capitulum radii. Durch solche Frakturen kann leichter eine *habituelle* Ellbogenluxation entstehen, obwohl diese ausserordentlich selten sind. Noch steht im Hauptprinzip BARDENHEUER's Ausspruch im Jahre 1888 fest: »Die Wiederverrenkung kommt nur bei gleichzeitig bestehender Fraktur vor, besonders des Pfannenrandes, des Radiusköpfchens, des Processus coronoides, des Olecranon, eines ganzen Condylus u. s. w.«

Hierzu kann ausgiebige Kapsel- und Bandzerreissungen oder auch eine Ruptur des M. brachialis internus gelegt werden (UHR-
LICH'S 1878). Weiter Epikondylfrakturen (ALBERT 1871, doch nicht unten referierter Fall von A., HEUSNER 1894, Bloch 1900) oder zurückgebliebene Entwicklung des Condylus internus humeri nach im Alter von 2 Jahren entstandener Fraktur (PERITZ 1924).

Im Gegensatz zu den Schulterluxationen kommen die Ellbogenluxationen vorzugsweise in den jüngeren Jahren im Alter von 5—25 Jahren vor. Man hat auch diese Form von Luxationen, *luxations congénitales* nach MALGAIGNE, bei Neugeborenen vorgefunden. Ein solcher Fall ist nach M. im Jahre 1812 publiziert worden und soll wegen der Seltenheit hier citiert werden:

»Une jeune dame, au commencement du 9:e mois de sa grossesse, ressentit tout à coup des mouvements si brusques de son enfant, qu'elle faillit perdre connaissance. Ces mouvements se répétèrent à trois reprises dans l'intervalle de dix minutes, après quoi tout rentra dans l'ordre, et l'accouchement se fit naturellement au terme accoutumé. L'enfant était pâle et faible et portait une luxation complète de l'avant-bras gauche en arrière de l'humérus.«

MALGAIGNE, der den Fall mitteilt, macht folgende Reflexionen:

»Mais ici les muscles ont-ils tout fait? Si l'on considère que jamais convulsions n'ont produit de semblable déplacement hors de l'utérus, il paraîtra beaucoup plus vraisemblable que l'avant-bras aura heurté l'utérus, comme il aurait heurté le sol, et que la luxation s'est produite par un mécanisme comparable à celui des luxations traumatiques.«

Dieser Fall — abgesehen davon, ob die Beobachtung und Erklärung richtig sind — wie das gewöhnlichere Vorkommen der Ellbogenluxationen bei den jüngeren Jahresklassen hat sein Interesse für die Beurteilung der Voraussetzungen zu der Entstehung dieser Luxationen, nämlich der Bau des Gelenkes während einer Zeit, da das Skelett noch nicht seine endgültige Form erhalten hat.

Aber erst einige Worte über den Begriff *habituelle Luxation* in diesem Zusammenhang. Man muss BLOCH's Definition 1900 bestimmen, dass man mit einer habituellen Luxation meint »eine solche Luxation, welche bei einem durchaus gesunden Gelenk zum ersten Male durch irgend eine äussere heftige Gewalteinwirkung veranlasst, sich später wiederholt bei Gelegenheit äusserer Einflüsse oder Muskelaktionen, die unter gewöhnlichen Bedingungen unfähig wären, eine solche Verschiebung zweier Gelenkenden hervorzurufen«. Die Verrenkungen folgen sich immer häufiger; ihre Entstehung ist eine immer leichtere.

»Mit der habituellen Luxation eng verwandt ist der *willkürliche* Luxation, die durch bestimmte Gelenkstellung, durch inkoordinierten Muskelzug, durch Willensimpuls herbeigeführt werden kann. Kongenitale Einflüsse sind hierbei häufig nachweisbar.« (SOMMER.) Eine Schlaffheit in den das Gelenk stärkenden Geweben entsteht durch die Primärverletzung, wodurch die Luxation sich wiederholt. Aber auch eine anatomische, kongenitale oder erworbene, Unregelmässigkeit kann die Ursache sein.

Was in der Literatur über Operationen bei Luxationen des Ellbogengelenkes angeführt ist, scheint nur die Frakturkomplikationen und die inveterierten, nicht reponiblen Luxationen zu be-

rühren. In den grossen amerikanischen, deutschen und englischen Operations- oder frakturheirurgischen Lehrbüchern (NELSON, BIER-BRAUN-KÜMMEL, WATSON-JONES) steht nichts. Als ich also eines Tages 1947 einem Patient mit einer habituellen Luxation nach hinten im Ellbogengelenk ohne röntgenologisch wahrnehmbare Frakturkomplikation gegenüberstand, hatte ich keine Anweisung eines operativen Verfahrens.

Aber zuerst zu dem Falle:

Ein 34-jähriges Fräulein (Journ. 2571/47). Ohne anamnestiche Krankheiten der Gelenke oder rheumatisches Leiden. Sie ist klein und zart gebaut. Länge 144 cm. Gewicht 40 kg. Am $11/10$ glitt sie aus und zog sich eine Luxation nach hinten in dem rechten Ellbogen zu. Die Luxation wurde leicht im Krankenhause reponiert. Die Röntgenaufnahme nach der Reposition zeigte keine Skelettveränderungen im rechten Ellbogen. Die Röntgenaufnahme des linken Ellbogens wies auch keine Skelett- oder Gelenkveränderungen auf mit Ausnahme von einer minimalen Verkalkung der Weichteilen ausserhalb Olecranon. Nach der Reposition wurde nur eine Mitella angelegt. $26/10$ entstand während des Schlafens eine neue Luxation. Die wurde bald nachher reponiert und 2 Wochen in Gipsverband gelegt. Als die Patientin am $21/11$ zu arbeiten anfang — gewöhnliche Hausarbeit — entstand eine neue Luxation. Es wurde vor der Reposition eine neue Röntgenaufnahme gemacht, wobei man eine Luxation nach hinten fand ohne etwas bemerkenswertes des Skelettes (Bild 1).

Nach der Reposition ging sie in ihre Arbeit, aber der Unterarm verrenkte sich aufs neue etwa 15 mal. Die Luxation entstand bei leichten Anstrengungen, beim Heben, Grüssen u. dergl. Sie hatte volle Beweglichkeit im Ellbogengelenk. Die Luxation ging immer nach hinten bei Hyperextension von dem Unterarm. Ihr Zustand war nun so unerträglich, dass sie willig war sich einer Operation zu unterziehen auch als es ihr gesagt wurde, dass sie vielleicht nach der Operation nicht den Unterarm würde voll ausstrecken können. Der linke Unterarm zeigte ung. 12° Hyperextension. Am $1/4$ 1948 wurde die Operation des rechten Unterarms ausgeführt nach unten angegebener Technik.

Ehe ich zu dieser Technik und Planlegung derselben übergehe, will ich zuerst einige Worte über die Anatomie des Ellbogengelenkes und über die Anatomie des Gelenkes in diesem speciellen Fall sagen, so wie sie aus den aufgenommenen Röntgenbildern hervorgeht.

HULTKRANTZ hat in seiner Dissertation im Jahre 1897 eingehend das Ellbogengelenk aus anatomischem Gesichtspunkt beschrieben. Er hebt hervor, dass die Oberfläche des Gelenkes, Incisura semilunaris ulnae (hier auch Ellenzange genannt) einem Sektor in einem Kreisbogen auf beinahe 90° entspreche. Diese Arbeit ist

ausschliesslich auf anatomisches Material gebaut und vor der Zeit des Röntgen gemacht. Sieht man doch die Bilder H:s an, kann man für die *Ellenzange* den Sektorwinkel, unten *Bogenwert* genannt, ausrechnen. Er ist fast 180° durch die Mitte der Ulna. *Capitulum humeri* stellt nach FICK (I. S. 194) fast einen Halbkreis von 1 cm. Radius dar und hat einen Bogenwert auf 180° . Der Bogenwert für *Trochlea* ist in der Mitte nach H. »etwa 280° «; also 80° weniger als die ganze Kreisperipherie.¹

Was die *Trochlea* betrifft sagt FICK (I: 188):

»Der Knorpelüberzug steht meist vorn und hinten gleich hoch; er umgibt mehr als $3/4$ (etwa 280° — 320°) des ganzen Rollenumfanges. Zum vollen Kreisumfang fehlt der Rolle hier nur das kleine Stück, das der (meist 2—3 mm.) Zwischenwand zwischen der vorderen und hinteren Obergelenkgrube entspricht.«

HULTKRANTZ äussert weiter, dass

»das Ellbogengelenk des Neugeborenen unterscheidet sich von dem des Erwachsenen hauptsächlich durch eine geringere Tiefe der Gelenkgruben, eine nach innen weniger breite *Trochlea* und eine entsprechend schmalere *Incisura semilunaris* — — —«. Weiter heisst es: »Die *Fossa olecrani* ist beim Neugeborenen bei weitem nicht so tief wie beim Erwachsenen und die *Fossa coronoidea* ist bei jenem nur schwach angedeutet. Relativ besser entwickelt ist das *Olecranon* selbst, wodurch natürlich eine Hemmung bei der Streckung beim Neugeborenen früher als beim Erwachsenen eintreten muss. Oft kann man das Ellbogengelenk eines grösseren Foetus oder eines Neugeborenen auch nach Wegnahme der Muskulatur nur bis zu einem Winkel von 150° — 160° strecken. Der Winkel der stärksten Beugung scheint dagegen dem des Erwachsenen ziemlich nahe zu stehen und c:a 40° zu betragen. — — — Die Knochenlamelle, die beim Erwachsenen die Gruben von einander trennt, erreicht in der Regel nicht die Dicke derselben Knochenwand beim Neugeborenen, wo sie bis zu $4\frac{1}{2}$ mm. betragen kann.«

Hier haben wir das Hindernis der vollen Extension bei jüngeren Individuen. Die oben genannte Lamelle kann während der Jugendjahre immer mehr der Resorption ausgesetzt werden und kann zu einer wirklichen Durchbrechung der *Fossa olecrani* (sog. *Perforatio olecrani*) übergehen. Bei den Schweden kommt eine solche nach H. in 4.7 % bei Männern und 14.8 % bei Frauen vor. Ob diese Perforation ein atavistisches Zeichen ist, was WIEDERSHEIM 1893 behauptet, hält doch H. für unbewiesen.

Eine andere wichtige anatomische Eigenart des Ellbogens ist

¹ Man konnte also im Verdacht haben, dass die Aufgabe H:s Seite 49 für den Bogenwert »als 90° « ein Druckfehler wäre.

die ungleiche Exkursionsumfang bei den beiden Geschlechtern, was teilweise mit obengenanntem öfterem Vorkommen von einer Perforatio oleerani bei Frauen zusammenhängt. Nach FICK (II: 290) ist der Bewegungsumfang — von äusserster Streck- zu äusserster Beugstellung — am Bänderpräparat beim Mann etwa 135° , beim Weib etwa 140° . An der Leiche einer graeilen Frau war die Hyperextension 25° , so dass der Totalwinkel 205° gross war. Eine Hyperextension ist gewöhnlicher bei Kindern als bei Erwachsenen. In meinem Falle war die Hyperextension der gesunden Seite 12° . Eine Perforatio oleerani konnte nicht auf den Röntgenbildern konstatiert werden.

Betreffend die Verrenkung im Ellbogengelenk sagt LANZ-WACHSMUTH ebenso, dass diese kommen vorwiegend beim jugendlichen Menschen und beim weiblichen Geschlecht vor,

»weil bei diesen die physiologische Überstreckbarkeit Verrenkungen begünstigt und auch die hemmenden Knochenhöcker nicht so stark entwickelt sind. — — — Bei Fall auf die Hand des im Ellbogengelenk gestreckten Armes wird die gegen ihre Grube angestemmte Gelenkkapsel in der Ellenbeuge der Unterarm nach hinten geschoben und durch die Beuger in Beugstellung festgehalten. Hierbei kommt der Kronenfortsatz der Elle häufig zu Schaden, selbst bei Kindern, bei denen er noch knorpelig ist.«

Um die anatomischen Variationen der verschiedenen Altesjahre zu erforschen wäre eine röntgenanatomische Studie von Incisura semilunaris' Tiefe und Trochleas Grösse und Bogenwert von Interesse. Bei Messung auf den Röntgenbildern in meinem Falle mit Rücksicht auf die Tiefe und den Bogenwert der Ulnargelenkpfanne — eine Untersuchung die als sehr unsicher betrachtet werden muss wegen der ungleichen Projektion bei dem Aufnehmen der Bilder — stellt es sich heraus, dass die rechte Gelenkpfanne 6.6 mm. tief ist und ein Bogenwert von 112° hat, während die Linke 8 mm. tief mit einem Bogenwert von 134° ist. Ulnas Diameter von der Spitze des Proe. coronoideus (der Coronoideusdiameter) ist rechts 2.5, links 2.8 cm. (Bild. 1 u. 2). Die rechte Gelenkpfanne ist also flacher als die linke und die rechte Ellenzange ist kürzer als die linke. Die Bedingung der Entstehungsmöglichkeiten einer Luxation ist also bedeutend grösser rechts als links, wenn überhaupt diese anatomischen Faktoren eine Bedeutung der Entstehung von Luxationen in dem Ellbogengelenk haben.

Die in der Literatur genannten habituellen Luxationsfälle, alle



Bild 1. Rechter Ellbogen.

mit Epikondylfrakturen kompliziert, sind, wie oben angeführt, sehr selten.

Fall HEUSNER (1894). Ein 13-jähriger Junge, der einem Unglücksfall ausgesetzt wurde und eine Luxation nach hinten in dem linken Ellbogen bekommen hatte. 8 Tage später wurde das Gelenk reponiert und 3 Tage fixiert. Danach während der nächsten sieben Wochen 3 Luxationsrecidiv, alle in Verbindung mit Turnübung am Reck. Während der folgenden $1\frac{1}{2}$ Jahre, also 85 Wochen nach dem ersten Unglücksfall, keine neuen Luxationen. Der Patient schonte doch seinen Arm. Danach wiederholte Luxationen, praktisch genommen bei jedem Aufheben eines schweren Gegenstandes. Infolge seines Zustandes musste $1\frac{3}{4}$ Jahre nach dem Unglücksfall eine Operation vorgenommen werden, wobei mit Knochenzange und scharfem Löffel die Incisura semilunaris soweit ausgehöhlt wurde, dass sie die Trochlea in früherer Weise umfasst. — Der äussere Condylus war durch Fehlen des Epicondylus verflacht und verbreitert. Ein Knochenstückchen hing mit einem sehnigen Streifen — den Resten des äusseren Seitenbandes — mit dem Radiushalse zusammen. Ob dieses Knochenstückchen weggenommen wurde geht nicht klar hervor aber ist wahrscheinlich. Unter allen Umständen wurde seine Knorpelfläche abgetragen. Die Wunde wurde mit Gazeballen ausgetopft. Die Observationszeit nach der Operation war kurz, so dass nichts sicheres über das Endresultat gesagt werden kann. »Das Gelenk zeigt eine Neigung zum steif werden«, wurde 6 Wochen nach der Operation notiert.

Die Bogenlänge der Incisura semilunaris ulnae — bei der Operation

untersucht — war zum »1/3 Kreissegment« verkürzt. »An Stelle der scharf vorspringenden Kante des Processus coronoideus fand sich ein niedriger abgerundeter Rand, welcher ebenfalls mit erweichtem und verdicktem Knorpel überzogen war.« Alle am Gelenke teilnehmenden Knochenenden waren verändert, sowohl Humerus wie Ulna und Radius. Epicondylus externus frakturiert. Der Bogenwert der Incisura semilunaris ist klein, 120°.



Bild 2. Linker Ellbogen.

In dem Falle BLOCH von 1900 handelte es sich um einen 19-jährigen Eisenbahnarbeiter, der im Alter von 13 Jahren ($13\frac{1}{12}$ 1893) den linken Ellbogen nach hinten luxierte. Er wurde sofort reponiert und mehrere Wochen fixiert. Im Februar eine neue Luxation, die ebenfalls sofort reponiert wurde. Ebenso 1895, 1896, 1898 und 1899, wobei auf dem Röntgenbild ein Corpus mobile in dem Gelenk beobachtet wurde. Bei Messung vom Bogenwert — nur der eine Ellbogen wurde geröntgt, — war dieser nur c:a 157°. Das Röntgenbild war aber schlecht. Arthrotomie und Entfernung von dem »freien Körper«, der durch schwache, faserige Massen mit dem Radius verbunden war. Proc. coronoideus vollständig unverändert. Der freie Körper entspricht durchaus dem Epicondylus externus. 3 Wochen Fixation. 2 Monate nach der Operation konnte der Patient mit seinem linken Arm jede schwere Arbeit tun.

Im Falle PERITZ (1924) handelte es sich um einen 12-jährigen Idioten, der im Alter von 2 Jahren eine Fraktur des inneren Humeruskondyls

bekommen hatte. Bei der Untersuchung 1924 hatte er eine hochgradige Cubitus varus links. Willkürlich kann durch Überstrecken eine Luxation des Unterarmes nach hinten hervorgerufen werden. Leichte Reposition. Schlottergelenk ebenfalls im rechten Ellbogen. Willkürliche Subluxation beider Daumen. Röntgenuntersuchung: Mangelhafte Entwicklung der Condylus internus. Einige Bilder der Beurteilung der Grösse der Trochlea und des Bogenwertes werden nicht mitgeteilt. Der Verfasser meint doch: »Die geringe Entwicklung der Trochlea in Verbindung mit der angeborenen Schlaffheit der Gelenkkapsel führt zur habituellen Luxation.«

Dieses zeigt auch die Bedeutung der Form und der Grösse der Gelenkflächen für das Entstehen der habituellen Luxationen wie auch die Einwirkung einer Fraktur auf den Zuwachs.

Der älteste Fall von habitueller Luxation ist von ALBERT 1871 mitgeteilt. Ob hier auch eine Epikondylfraktur mit im Spiele ist, geht nicht klar hervor. Hier handelte es sich doch um eine unvollkommene, willkürliche Verrenkung nach innen. Ein 10-jähriger Knabe ist vor 4 Wochen auf der Gasse gefallen. Kurze Zeit darauf hat die Mutter bemerkt, dass dem Knaben das Gelenk 'überschnappe'. Der Kranke konnte bei Beugung bis zu einem Winkel von 90° den Vorderarm medial luxieren. Durch eine geringe Anstrengung konnte er bei ganz frei herabhängendem Arm denselben aus der Luxationsstellung in die normale überführen. ALBERT ist geneigt anzunehmen, dass die Luxation beim Unglücksfall schon eine alte gewesen ist, d. h. schon vor dem erwähnten Sturz bestanden habe und von den wenig intelligenten Eltern übersehen worden sei. Der Knabe hatte in der frühen Kindeszeit an Convulsionen gelitten.

Bemerkenswert ist, dass habituelle Luxation nach hinten in allen in der Literatur erwähnten Fällen bei jungen Individuen eingetroffen ist: HEUSNER, 13 Jahre, BLOCH, 13 Jahre, PERITZ, 12 Jahre, alle männliche Individuen. Auch in dem soeben angeführten Fall von ALBERT handelte es sich um einen 10-jährigen Jungen. Dieses kann auch auf die Bedeutung der Form der Gelenkflächen für die Entstehung der Luxation hinweisen, da ja das Skelett in den Jugendjahren in Entwicklung ist.

Mein oben angeführter eigener Fall, ein 34-jähriges kleines und zartes Fräulein, zeigt dagegen, dass solche habituelle Luxationen auch entstehen können nach dem der Zuwachs des Skelettes beendigt ist. Möglicherweise ist in den Reifejahren eine Hemmung von dem Zuwachs der Incisura semilunaris eingetreten, wodurch der Bogenwert der Ellenzange kleiner geworden ist und Cavum flacher. Traumata oder Frakturen sind nicht vorgekommen. Auch keine Zeichen dass die Spitze des Proc. coronoideus bei dem Un-

glücksfall 1947 oder früher verletzt worden war. Dieses macht, dass mein Fall in seiner Art einzig ist.

Nach JOESSEL liegt die Ursache der Wiederholung von Schulterluxationen in den das Gelenk umgebenden Muskeln und Sehnen. Denkt man an das Ellbogengelenk kommen die Brachialis internus und Triceps in Betracht, die mit einer Anzahl von Fasern an der Kapsel sich ansetzen. Dass Brachialis internus an der Vorderseite des Gelenks verletzt wird, geht teils von dem hier referierten Fall von HEUSNER, wo »die Sehne des Museulus brachialis internus in einen dürrtigen Strang, /der bei der Operation abbriss, verwandelt war«, teils von den nach hinteren Ellbogenluxationen an dem Röntgenbild bisweilen beobachteten sogenannten Myositis ossificans-Fällen hervor.

Ich gehe nicht weiter auf das Problem von der Ursache der habituellen Luxationen im Ellbogen ein. Sie hat für mich doch eine gewisse Bedeutung für das Ausdenken der Therapie gehabt. Die Luxation war in meinem Fall gerade nach hinten hin. Keine Frakturen oder Gelenkkapselrupturen wurden beobachtet. Keine abnorme Varus- oder Valgusstellung; auch kein Wackeln in der Kondylebene. Der Cubitalwinkel, d. h. der Winkel zwischen Humerus' Längsrichtung und der Achsel des Ellbogens, war 85°. Hyperextension 12°. Flexion bis 40°. Ebenso an der linken Seite. Die flachere Ellenzange und der kürzere Bogenwert veranlassten mich als Therapie eine Vergrößerung desselben und eine Vertiefung von Incisura semilunaris zu machen. Ich nahm dann auch in Betracht, dass eine ausgebliebene Hyperextension und vielleicht auch eine verminderte Extension die Folge einer Operation werden könnten. Die Operation sollte auf die Weise gemacht werden, dass sowohl Olecranon als Proc. coronoideus ausgebaut wurden. Gleichzeitig sollte das Gelenk wenn möglich nicht geöffnet werden oder unter allen Umständen in unbedeutender Ausstreckung.

Die Technik wurde darum die folgende: Durch einen medialen Längsschnitt mit einem quergehenden Bogenschnitt oberhalb Olecranon wurden die Spitze und die Tricepssehne freigelegt wobei die Gelenkkapsel in die Höhe geschoben wurde. Die Innenseite von Proc. coronoideus unter Ligamentum collaterale wurde freigelegt nach dem Losmachen der obersten Muskelfäden von Flexor digitorum profundus von ihrem Ursprung auf Ulnas medialer Fläche. Von Crista ilii wurde ein L-geformtes freies Transplantat mit dem horizontalen Schenkel von der dickeren Crista ilii-Partie genommen. Das Knochenstück war 1 1/2 cm. breit und 2 cm. lang

und wurde mit dem vertikalen Schenkel in eine mit Meissel gemachte, längsgehende Spalte in Olecranon gelegt. Der dickere Teil wurde nach vorn gegen das Gelenk gelegt und mit einem rostfreien Stift fixiert. Die Olecranonspitze wurde also ausgebaut und mit 1 cm. verlängert. Mit dem Meissel wurde in der Basis von Proc. coronoideus eine Spalte gemacht, wodurch dieser



Bild 3. Rechter Ellbogen nach der Operation.

2 $\frac{1}{2}$ mm. aufgehoben wurde. In die Spalte wurde ein $7 \times 15 \times 2\frac{1}{2}$ mm. grosses Knochenstück von Crista ilii als Stütze für die aufgehobene Coronoideuspartie eingekeilt. Per-primam-Sutur. Gipsverband in 90° während 5 Wochen. Aufenthalt im Krankenhaus 9 Tage. $\frac{2}{6}$ 1948: Volle Flexion und Pronation-Supination. Maximale Extension bis 170° .

Bei der Untersuchung $\frac{31}{3}$ 1949 war die Exkursionsweite, Biegung-Streckung, 40° — 180° . Keine Luxationsneigung. Die Kraft normal. Der Patient sehr zufrieden mit dem Arm. Röntgenuntersuchung $\frac{15}{9}$ 48: Das aufgelegte und festgenagelte Knochenfragment auf dem Olecranon ist nun ossös damit vereint. Es ist im Verhältnis mit dem $\frac{6}{4}$ 1948 genommene Röntgenbild etwas reduziert in seinem Umfang. Incisura semilunaris ist leicht unregelmässig mit einer kleinen Einbiegung gegen das Gelenk an der Mittenpartie (wo Proc. coronoideus von dem eingelegten Knochen-

stück aufgehoben worden ist). Der Coronoideusdiameter ist rechts und links 2.8 cm. Vor der Operation war der Diameter rechts 2.5 cm. Die Messung der Ellenlange in Bezug auf Bogenwert und Cavitas-Tiefe zeigt rechts 155° und 9 mm. resp. links 134° und 8 mm. (Bild 2 u. 3). Das Metallstift wurde am 20/9 1948 fortgenommen.

Es scheint also, dass die Absicht den Bogenwert und die Tiefe der Ellenlange zu vergrössern, wodurch eine durch Hyperextension verursachte habituelle Luxation könnte vermeiden werden, in diesem Falle gelungen wäre. Unter allen Umständen ist das Resultat ein Jahr nach der Operation ausgezeichnet. Der Ellbogen zeigt normale Funktion und Kraft.

Kann man aus der Literatur und meinem operierten Fall einen Schlusssatz von der Ursache dieser seltenen habituellen Luxationsform machen? Wie ich vorher erwähnt habe, sind die auf den Röntgenbildern genommenen Messungen sehr unsicher, da man nicht garantieren kann, dass die Entfernung von Röntgenfocus zu den Filmen und die Projektion im übrigen ganz gleich sind. Aber in meinem Fall zeigen die auf den Filmen genommenen Messungen, dass die Tiefe und den Bogenwert der Incisura semilunaris rechts kleiner als links war und kleiner vor als nach der Operation. Darum kann man nicht die Möglichkeit ausschliessen, dass anatomische Voraussetzungen in der Form und Tiefe der Incisura semilunaris vor der Operation für das Entstehen einer habituellen, hinteren Ellbogenluxation vorhanden waren.

Summary.

The writer describes one nearly unique case of habitual dislocation backwards in the elbow joint by a 34-year-old woman without visible fracture on X-ray-pictures. The author mentions to some extent the anatomy of the humero-ulnar-joint and gives a short account of the possible presumptions for the origin of the luxation in question. From the medical literature he mentions 4 similar cases by children 10—13 years old. 3 of these had fractures on the epicondylus humeri. The author describes the used method of operation. The design of these was built on the supposition that the incisura semilunaris ulnae was too shallow and the joint face was too short. Through measurements on the X-ray pictures in the case of the author are these conditions with great probability

verified. The surgical treatment consisted in building on the incisura semilunaris backwards and forwards using bone graft from the crista ilii to the olecranon and to the processus coronoideus ulnae. 1 year after the operation complete success. The measures on X-ray pictures before the operation: 112° and 6.5 mm. $3/4$ year after the operation: 155° and 9 mm. On the other side: 134° and 8 mm.

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On Injuries to the Posterior Horn of the Medial Semilunar Cartilage.

By

IVAR PALMER.

The question may be raised whether injuries to the posterior horn of the medial semilunar cartilage deserve a special paper. Are not all injuries to the cartilages, despite a certain unpredictable variability, more or less uniform as far as clinical features, pathogenesis and treatment are concerned? I have come to believe that this is not the case, that the symptoms of posterior horn injuries are different from those of other cartilage injuries and that their pathogenesis is probably also not entirely similar. Partly as a result of this and partly for surgico-technical reasons, their treatment, too, is different.

Although the literature is more than abundant with regard to cartilage injuries in general, it is remarkably meagre concerning the posterior horn injuries. The explanation of this is probably that the latter injuries frequently remain undetected. They are much more unusual than the typical medial cartilage injury, and their diagnosis is more difficult.

During the past two years I have operated on 21 cases of medial posterior horn injury. The first few cases were disclosed accidentally and were encountered at long intervals. As I became increasingly familiar with the symptoms, however, I began to find the injury more often.

Clinical features: The principal signs of the typical medial cartilage injury are a local synovitis in the region of the damaged cartilage and a temporary or permanent obstruction to extension caused by a part of the cartilage being caught between the artic-

ular surfaces. This combination of local synovitis and "locking", revealed by negative direct radiography, makes the diagnosis of meniscal injury almost certain.

The posterior horn injury, too, causes synovitis, which is generally manifested by tenderness over the posterior portion of the joint space. However, as a rule it does not cause locking in the sense of obstructed extension. Thus, the most typical symptom on which to base the diagnosis is lacking. Comparison of the 21 cases gives a rather varying picture, with, however, certain typical characteristics, which make it possible to recognize or at least suspect the truth. To begin with, the injury is most common in relatively elderly persons. My oldest patient was 65 years, my youngest 18, but the average was 42 years. The sex distribution was about equal, with 12 men and 8 women. The ordinary cartilage injury, on the other hand, is most frequently found in males between the ages of 18 and 30 years.

The mechanism of the ordinary injury to the semilunar cartilage is fairly thoroughly understood. It is described by WATSON-JONES as follows: When the knee is flexed and abducted, the middle part of the medial cartilage is sucked in between the joint surfaces. If extension with simultaneous rotation then occurs, the meniscus may be caught between the articular surfaces and torn from its margin by the rotation. The result is the typical longitudinal rupture.

The posterior horn acts as a buffer when the joint is strongly flexed. In accordance with the foregoing, it might be imagined that a posterior horn injury would occur if rising from a squatting position were accompanied by torsion, in other words rotation in the joint. Exactly this type of movement was described spontaneously by two of the patients as the cause of the onset of symptoms. No adequate trauma could be discovered in the remaining 19 cases, however.

MCMURRAY has described a sign which is claimed to be pathognomonic for posterior horn injury. On the whole, his theory is based on the same type of mechanism as the one described by WATSON-JONES. With the subject supine, the knee joint is fully flexed, after which it is extended while the leg is rotated inward and outward at the knee. At some point during extension a click should be heard and felt inside the joint. A stubborn search was made for this sign in all the cases in the present series, but it was found in only one patient. I am inclined to believe that



Fig. 1. Injury to the posterior horn in arthrographic picture with perabrobil.



Fig. 2. Three specimens of posterior horn injuries of type II.

PALMER: Injuries to the Medial Semilunar Cartilage.

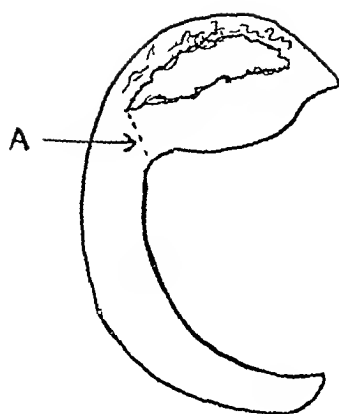


Fig. 3.

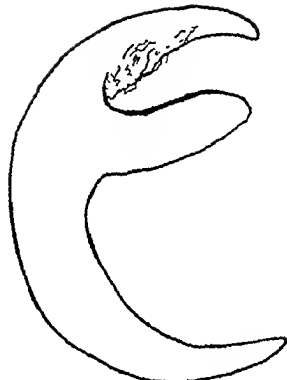


Fig. 4.

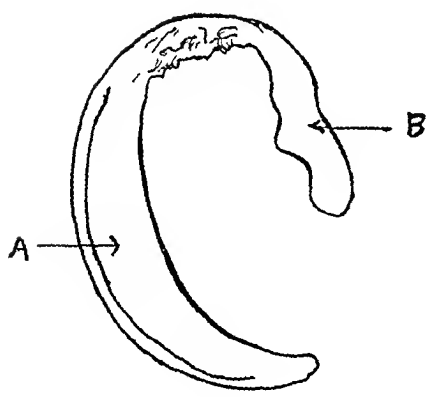


Fig. 5.

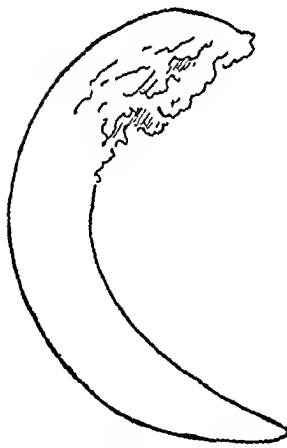


Fig. 6

McMURRAY's sign actually is only an accidental occurrence: in some cases the loose portion of the posterior horn catches between the articular surfaces and then is released with a click.

All the cases showed local synovitis with tenderness over the medial joint space, sometimes the whole way and sometimes only over the posterior circumference of the joint. Several of the cases had such pronounced tenderness over the area lateral to the semimembranosus tendon in the popliteal fossa that semimembranosus bursitis was suspected. In five cases the synovitis was diffuse with exudation into the joint. One case had pronounced intermittent hydrops, which cleared up following surgical treatment.

When questioning a patient concerning "locking", it should be borne in mind that this is an ambiguous expression and that the patient may interpret it quite differently from the questioner. By locking, of course, is meant an obstacle to extension of acute onset. Seven of the patients reported, although most of them rather hesitantly, that there had been "locking". More often, however, the patients said they felt "as if something had gone out of joint inside the knee". Sometimes they described their symptoms only as a feeling of insecurity. Nine patients, however, reported a distinct sensation of internal derangement, which released itself with a click.

Roentgen examination showed distinct signs of arthritis in five cases. Arthrography was done in seven cases, in six of which the findings were positive. (Fig. 1.)

Treatment: Surgical treatment is indicated in injury to the posterior horn of the medial semilunar cartilage unless the joint is the site of pronounced arthritic changes.

Only in exceptional cases is an injury to the medial posterior horn accessible through an anterior incision. Combined anterior and posterior arthrotomy is usually required. Experiments have been made with Cave's incision, in which the opening in the capsule, through a common skin incision, is made in front of and behind the collateral ligament with the knee hanging over the table. However, this method allows considerably less satisfactory access than the posterior incision described in the following.

As a rule the joint was opened with a short medial parapatellar incision. Inspection of the meniscus in posterior horn injury sometimes does not reveal the damage at first glance. However, the torn or detached parts of the posterior horn can be pulled out

with a squint hook and the diagnosis thereby verified. It is not advisable and has never been necessary, as various workers recommend, to begin detaching the meniscus without verifying that it has been damaged in the hope that the injury will come to light after the cartilage has been rendered more mobile through dissection. In 8 of the cases the meniscus was removed through an anterior incision only and in 13 through a combined anterior and posterior incision.

Combined anterior and posterior arthrotomy has recently been used increasingly often; the eight cases with an anterior incision only belong to an earlier period. The reason for this is that we have become more and more firmly convinced that the posterior horn cannot as a rule be removed satisfactorily through an anterior incision only. The following case illustrates this point.

A 41-year-old business man had been suffering recurrent exudation in the left knee, as well as a feeling of insecurity and of "something going out of joint" inside the knee for two years. Operation was done with anterior arthrotomy, revealing a longitudinal rupture without dislocation of the medial semilunar cartilage (fig. 5). Portion *A* of the meniscus was removed. The patient's condition was the same if not worse after the operation, and it was concluded that the back end of the cartilage had been overlooked. Six weeks later portion *B* was removed through a posterior arthrotomy. The patient had no trouble thereafter.

Another patient, an unmarried woman of thirty years, exhibited similar symptoms. She had been operated on earlier at another hospital, but the symptoms still persisted. She recovered completely after posterior arthrotomy with removal of the remains of the posterior horn. The appearance of the meniscal remains is shown in fig. 3. If the rupture had continued as shown by the dotted line, the injuries would have been similar to the one in fig. 2 a.

The meniscus is detached as far back as possible through the anterior incision, after which the patient is placed in the prone position. The posterior incision follows the semimembranosus tendon. Entrance is made into the loose space between the tendon and the medial margin of the head of the gastrocnemius, which is elevated postero-laterally. The posterior capsule is now accessible, and the joint is opened by a vertical incision. We are now directly over the posterior horn of the cartilage, and the posterior half of the meniscus can be extirpated without difficulty. No vessels need be ligated in connection with the posterior incision. The incision gives quick and convenient access to the posterior part of the joint.

The incision is closed with only one or two sutures through the fibrous capsule, the musculature is allowed to fit together and the wound is closed by suturing the skin.

The postoperative course following combined arthrotomy has been remarkably free from complications — much more so than following anterior arthrotomy only. The reason for this is not difficult to find. The posterior incision with only one or two sutures allows the joint to drain backward into the loose connective tissue of the popliteal fossa, in other words into tissue with a good absorption capacity.

If this observation is correct, it invalidates the main objection to combined anterior and posterior arthrotomy, namely that it complicates the operation and thereby prolongs convalescence.

Operative findings: It is the consensus of opinion that deforming degenerative changes play a part in injuries to the cartilage. The interrelationship between degeneration and trauma naturally varies. In the usual meniscal injuries affecting young adults, degeneration is probably of little or no importance, trauma being the paramount or sole factor.

But in injuries to the posterior horn, it would seem that this relationship is the exact reverse, degenerative changes monopolizing the picture completely.

On the basis of the foregoing the present material can be divided into three groups:

I) In six cases we found a longitudinal fissure in the posterior horn, it being possible to displace the mobile portion of the meniscus into the joint. The fissure followed a more or less oblique course through the meniscal substance roughly on the horizontal plane (figure 3).

The average age in this group was rather low — 25 years. We may therefore be justified in assuming that this type of injury constitutes an early stage of posterior horn damage.

II) In eleven cases, the fissure had advanced, the fragment had become pedunculated, and as the pedunculation progressed in a medial or lateral direction, the fragment had come to have its insertion medially in the circumference or laterally toward the tibia. (Fig. 4—5.)

The average age of these patients was 46 years, or considerably higher than in the foregoing group.

An injury of this kind cannot be repaired satisfactorily by anterior arthrotomy only. Four of the patients had previously

undergone ordinary meniscectomy through an anterior incision. A portion of the cartilage had been overlooked and gave rise to the symptoms which were later relieved by posterior meniscectomy.

III) Four cases showed no clearly defined rupture, but the posterior end of the meniscus was the site of pronounced degenerative changes with edematous, disintegrating cartilage. The neighbouring synovial membrane was highly inflamed and swollen. Here the condition can be characterized as meniscal chondromalacia. These patients were relatively old, the average age being 54 years. Fairly advanced arthritic changes were found in one of the cases, the remainder having very moderate arthritis.

All these cases were operated on with combined anterior and posterior arthrotomy. The condition was verified from the front with a squint hook (Fig. 6).

All the patients were free from symptoms after the operation. It is a technical impossibility to remove a cartilage of this kind with an anterior incision only (Fig. 2).

Summary.

1) The diagnosis of injury to the posterior horn is relatively difficult, but the condition can be suspected on the basis of local synovitis and clicking and a sensation of insecurity or derangement in the posterior part of the joint. In the hands of an experienced roentgenologist, arthrography will generally serve to verify the diagnosis.

2) Degeneration dominates the picture in these injuries to a much greater extent than in ordinary meniscal injuries. In some cases it takes the form of meniscal chondromalacia only. Furthermore, the injuries are found in older patients than the ordinary meniscal injury.

3) Combined anterior-posterior arthrotomy is to be recommended in these injuries. The operation involves a little more trouble for the surgeon, but the convalescence is generally easier for the patient than following anterior arthrotomy only. The posterior incision provides drainage for the joint, which is beneficial in the postoperative period.

4) Unless they suffer from pronounced arthritis, the patients may be expected to be free from symptoms after the operation.

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On Ischaemic Fracture Complications.

A Case of Arterial Aneurysm.

By

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In the treatment of all fractures it is essential to maintain adequate circulation of the blood. Defective flow, whether due to primal vascular injury or to tight bandaging, gives rise to so-called ischaemic contracture, which most frequently occurs in supracondylar fractures of the humerus and forearms of children, and goes under the name of the Volkmann contracture. As is known, the flexors and pronators are damaged to the extent of deformity, in other words pronation of the forearm as well as flexed position of the wrist and interphalangeal joints. This however does not include the extended or hyper-extended metacarpophalangeal joints. Similar ischaemic injury also occurs in the lower extremities but much less often. Here likewise the flexors become affected with typical contracture of the foot described as equinovarus and claw-like.

A contracture case of this type has recently been treated at our clinic in which the cause of the ischaemia was of a more unusual nature. The patient was a youth aged 19 who had sustained compound fracture of the tibia (Fig. 1) in a cycle accident. Severe haemorrhage outwards attended the injury, with subsequent swelling. He was admitted to another hospital and the primal treatment consisted in a few days' immobilisation of the limb in splints to reduce the swelling, whereupon plaster was applied. One month later, the plaster was removed and the foot was found to be paralysed and devoid of feeling. The development of this complication had thus not been observed. Four and a half months

after the accident the patient was transferred to the orthopaedic clinic for further treatment. The fracture was then consolidated. The foot was in an extreme equinovarus position, impossible of correction, and the extensors of the foot and toes as well as the fibulae lacked function. Pulsation of the *arteria dorsalis pedis* was absent. The foot was cold and anaesthetic and oscillations from the calf and downwards were considerably reduced. The calf-musculature was rather hard and there were two decubital sores above the Achilles tendon. Accordingly, a complete picture of ischaemic contracture. Such was the change revealed by roentgenograms however, that one was compelled to go further into the case. (Fig. 2.) An increase of distance was seen between the tibia and fibula which, latter, was bent in a lateral direction displaying compression-atrophy and periosteal reaction that indicated a diffusive process between the two bones. Pronounced systolic murmurings were heard on auscultation of the calf and on occasional investigations, pulsations were felt at a depth. The clinical picture argued for arterial aneurysm in one of the branches of the popliteal artery and this diagnosis was supported by arteriographs which revealed a collection of contrast 10 cm below the place where the popliteal artery branches, while showing that the distal part of the posterior tibial artery was empty of the same (Fig. 3).

An operation was performed and in front of the calf-musculature, a haematoma quite as large as a fist was disclosed lying at a depth and attached adjacently to the deflected fibula. The posterior tibial artery entered the sac, but the distal part of the former was obliterated. Ligation and division supervened. The sac, on being opened, was found to contain large quantities of partly organized clots of blood. At the orifice was a lesser cavity lined with an endothelium-like coating. At the bottom of the sac lay the tibia-fracture quite naked without periosteal clothing or visible callus, obviously due to the strong effect of the pressure involved through the pumping of blood by the artery into the sac. The posterior wall was excised, but the deeper parts of the haematoma sac were left untouched to avoid injuring the other two arterial branches or eventual newly-formed collateral blood vessels. The peroneal nerve was explored. It did not seem to have been exposed to pressure and, macroscopically, was of normal appearance. Immediately after the operation, strong pulsation was palpable in the *arteria dorsalis pedis*, and the injured foot

became warmer than the other. The increase of warmth and strong pulsations remained for several days but, on the other hand, the oscillations were not affected. A few days after the operation already, one observed that the extensors and fibulae were in function and that increase of the same occurred successively. The sensory impairment gradually diminished during the course of two months and is now, one year after the operation, residual only at the tips of the small toes. The trophic sores healed rapidly. In spite of diligent motory exercise the contractures were not overcome, and it was subsequently necessary to lengthen the heel-tendon and perform subastragalar arthrodesis in order to get the foot in a good position. Nine months after the operation Roentgen pictures showed that the fibular curvature had disappeared (Fig. 4).

The author has seen a description in the literature of a few cases of pressure-atrophy in the skeleton of arterial aneurysm, but in the form of local erosion of the bone and not of curvature, as in the above case. The explanation would seem to be that the growing bone is so elastic that it can give way, while in respect to adults, the pulsating haematoma hollows-out the bone.

Such aneurysm is no rarity in war-time. It is most common after deep, penetrating stabs and shell wounds but less frequent after fractures. War experienced vascular surgeons recommend auscultation in the examination of all penetrating wounds with abundant haemorrhage or severe swelling. In war-time one is more fully awake to the occurrence of aneurysm, whereas under peace conditions, it can be more easily overlooked.

The traumatic aneurysm is false. It is not a real bulging of the vascular wall. It is a haematoma which has become of sac-form and partly filled with coagulations. A better name would be pulsating haematoma. The diagnosis involves the following symptoms: tumour, pain, pulsation and systolic bruit. It is of importance to the operative treatment that arterial and arteriovenous aneurysm be differentiated. The latter generally discloses one or more fistulae between the artery and accompanying veins, and the bruit occurs throughout the cardiac cycle while attaining its highest degree in systole. Moreover, a thrill is palpable. If the fistula is wide, cardiac dilatation and decompensation may supervene. Compression of the artery proximal to the fistula involves bradycardia and enhancement of the blood pressure (the Branham sign), and Roentgen-examination reveals decrease of the heart

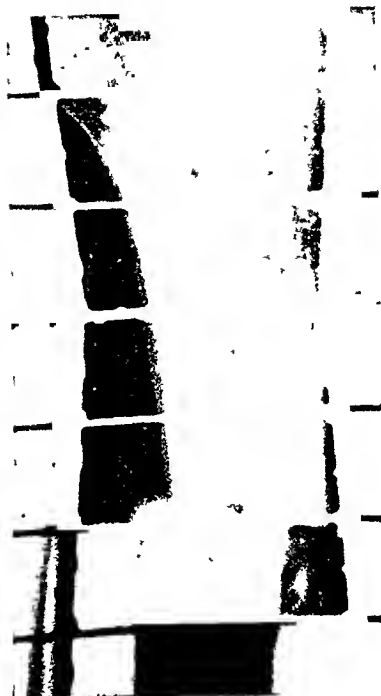


Fig. 1. The first roentgenogram after the accident.



Fig. 2. Roentgenogram 4 1/2 months after the accident.

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Fig. 3 Arteriogram



Fig. 4. Roentgenogram 9 months after the operation.

volume. Arteriography is a valuable diagnostic aid. Fistulae and arterialized veins with their valves can be disclosed through compression of proximal veins. There is a great risk of gangrene if such arteriovenous connections are overlooked and arterial ligation only is applied. Finally, at the operation one can feel thrill and also observe gyratory formations in the veins.

Rarely does the healing of arterial or arteriovenous aneurysm occur spontaneously, and on this account operation is the only treatment. If possible the operation should be postponed for at least 3—6 weeks, preferably 3—6 months after the accident so that the collateral circulation has had time to develop. This however is not often accomplishable for various reasons. With reference to the operative technique, I will only briefly touch upon a few fundamental rules. Arterial aneurysmal excision should not be performed in general, as the collateral vessels become involved, and this increases the danger of gangrene. It should be sufficient with proximal and distal arterial ligation and division of the artery for the possibility of retraction, and also obliteration of the haematoma sac. The so-called endoaneurysmorrhaphy was described as long ago as 1888 by MATAS one of the pioneers of vascular surgery. On the other hand, in reference to the arteriovenous fistula, it is of importance to remove the aneurysm following the proximal and distal ligation of the artery and vein, in order not to overlook any smaller fistula through which a recurrence might arise. (Further details relevant to the operative technique are to be found in the bibliography.)

It is obviously of the greatest importance to diagnose ischaemic conditions as early as possible so that one can intervene before irreversible changes develop with their deleterious consequences. Ischaemic contractures are rare. In his excellent survey with reference to the Volkmann contracture, GRIFFITHS reports only 8 of 21,000 fracture cases primarily treated at the Manchester hospital. Another frequency-figure published by BITTNER is 4 contracture cases of 2,850 arm fractures. Considerably more rare is ischaemic contracture of the lower extremities. In 1940, HORWITZ only found 20 described in the literature. The private surgeon thus has little prospect of meeting with such cases, at least during peace-time. His experience will be slight both as regards diagnosis and treatment. I therefore feel justified in issuing a fairly brief account of the more recent publications on the subject, without having personal experience.

The cause of contractures has always been an object of discussion. Nervous injuries, venous obstruction and arterial damages have been spoken of. Experimental and clinical observations favour the assumption that arterial injuries with accompanying ischaemia are primal. Pathologically-anatomically one finds dead muscular tissue surrounded by a sheath of fibrous tissue, the picture of an infarction. Due to denervation in contracture there occurs interfibrillary fibrosis, which is never met with in ischaemic cases. Injuries to the nerves are liable to manifest simultaneously and thus blur the clinical picture but many cases exhibit no such injury, at which the neurologic symptom of impairment is explained as ischaemic nervous injury. VOLKMANN himself was of the opinion that tight bandages were the chief cause but, later, many cases have been observed which had not been exposed to exterior pressure. Even if tight compressions can be regarded as contributory cause, the first of importance however is always the arterial injury. The tissues most sensitive to ischaemia are nerves and muscles. The musculature dies after 6—8 hours circulatory failure, but skin can survive 24 hours. This is the explanation why arterial occlusion in the one case leads to gangrene, and in the other, to contracture. The musculature is liable to necrotize in the event of such an incomplete circulatory blockade which does not end in gangrene.

Obviously, in arterial injuries the circulation is dependent on the condition of the collateral vessels. Given the chance to function the circulation will be sufficient even in the case of complete arrestation in the main artery. According to LERICHE they are affected by vasoconstrictoric reflexes from a damaged artery. Can these reflexes be interrupted, and preferably through excision of the artery, the circulation will be restored through dilatation of the collateral vessels. LERICHE maintains that these vasomotoric reflexes are of great significance to the continued development of the ischaemic process. Several authors, besides LERICHE have made operative observations which argue for the correctness of this mechanism.

With the point of departure from these pathogenic viewpoints one must plan the treatment. It is a question of hours, not days when the survival of the musculature is involved. An early diagnosis is therefore essential. The incipience of the disease can be acute, and then the symptoms, burning pain, edema and cyanosis are characteristic, thus rendering the case easy to diagnose. One

should not fail to remember however that the absence of pain can indicate simultaneous nerve injury. Unfortunately some cases are liable to run their course more stealthily without pain and severe swelling. The early dependable signs are cyanosis or pallor, reduced cutaneous temperature, sensory impairment as well as absence of peripheral pulsation and diminished oscillations. The first signs often manifest within some few hours but can delay one or more days. Flexion of fingers and toes, and pain on passive extension, are late symptoms, and probably then, the musculature is already definitely injured. Accordingly, is the question one of a fracture with the above described signs of impaired circulation, intervention must be as immediate as possible. Compressions shall be withdrawn. Gentle manipulation may relieve the artery and, by diminishing the pressure even improve the collateral circulation. Renewed violent manipulative reductions must be avoided. Risk of arterial occlusion in the elbow region is enhanced through fixation in acute flexion, for which reason the latter should be avoided if there are signs of vascular injury. If the circulation is not speedily restored one must have recourse to operative measures. Simple cleavage of the fascia, can lessen pressure on the collateral vessels in the event of severe haemorrhage, but it is preferable to explore the artery in question, whereupon the main branches should be investigated. The artery is liable to be quite severed, contused or lacerated, and arteriectomy shall be performed between the ligatures. Ligation in continuity is not sufficient. It does not prevent secondary thrombosis or haemorrhage and, moreover, the vasomotoric reflexes are apt to remain. Sometimes the sole occurrence is arterial spasm which can be relieved by widespread mobilization of the artery, and injection of local anaesthesia in and around the same. Chemical or operative blockade of the sympathetic is a valuable complement to all treatment. The most active surgeons prescribe primal operative exposition in every case which, from the beginning, reveals pronounced signs of circulatory impairment. In addition to guarding against future ischaemic injuries, the intervention has other advantages, for instance, the disclosure of a simultaneous nerve injury, which occurrence is not so rare. GRIFFITHS reports 14 of 29 cases of operated Volkmann contractures and other authors have still higher figures. Finally, the reduction and fixation of the fracture can be performed under observation, while reduction executed otherwise, at least relevant to supracondylar humeral fractures, can

often involve great difficulties. Thus, judging from the literature, it would seem apparent that surgeons with great experience in this domain, prescribe a more active therapy in cases threatening circulative disturbance, with the object of preventing ischaemic complications.

Summary.

A case of ischaemic contracture subsequent to compound tibial fracture is described. The cause of the same was proved to be arterial aneurysm (pulsating haematoma) which produced separation between the tibia and fibula. The importance of diagnosing circulatory disturbances at a very early stage before the musculature is definitely injured, is emphasized. To judge from the more recent literature relevant to ischaemic complications, greater activity would seem to be prevalent in the form of early exposure and resection of traumatic arterial segment.

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Some Radiological Aspects on the Carpal Scaphoid and its Fractures.

By

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In our days there is no divergence of opinion with regard to the importance to be attached to the diagnostical X-ray examination, for the demonstration of injury to the bones. As soon as the clinical examination has indicated the possibility of such damage, an X-ray examination is also undertaken with the object to study the extent and the appearance of the damage. More disputed is however the value of the X-ray investigation for answering the inquiry, whether a fracture or not has occurred. Unfortunately, this question is often debated without taking into consideration the X-ray technique. In some medical circles, one is still of the opinion that the presence of a fracture can be clinically established, and only then the X-ray examination is performed in order to determine the position of the fragments — at least in practice the mode of action still seems to imply that such conceptions are predominating. Of late years, the X-ray diagnostics in our country has made great advancements, but in a general way this does not apply to the X-ray investigation of bone and joints. On account of the ever-increasing amount of work, the X-ray examination of the bones has come to mean a procedure, where a nurse takes a number of more or less accurately produced views in certain standard projections which are then “interpreted” by a doctor. Of course, such standard projections supply various information but all details are by no means brought forward. At times it may be discovered that a given fracture was not visualized, or only faintly so, by the routine projections and that

another beam direction was needed to make it visible or to better bring forward the details. As a rule, this leads to the incorporation of another standard projection among the conventional ones — at least at the centre where the discovery was made. Such a way of proceeding has in fact nothing to do with a true X-ray examination but is only plain photography. The X-ray investigation is something more. It requires extensive anatomical knowledge, large experience with regard to the adequate projections for visualizing a given anatomical detail and with regard to the changing appearance of this detail with the changed direction of the X-ray beam. The radiologist, having made an orientating examination of the superficial anatomy of the patient and, may be, after studying a preliminary view, shall be able to decide how to modify a standard projection, with due consideration of the anatomy in the actual case, in order to bring forward the desired details. He shall be able to determine what views will provide the best answers to the clinical questionnaire. A complete mastery of the technique is needed for producing views sufficiently rich in contrast and of best possible sharpness. Mostly, the clinician has no qualifications for carrying out an accurate and complete X-ray investigation, his time can also be better employed. Results of benefit to the patient are certainly best obtained when there is a close collaboration between the clinician and the radiologist. From the understanding attitude of GUSTAF SÖDERLUND and his realization of the importance of radiology for the clinics, a co-operation in the course of time has developed between the surgical and the roentgen departments of the Seraphimer Hospital, which has proved fruitful to both parties and of great benefit to the patients.

The anatomy of the ordinary textbooks cannot — naturally enough — include all factors on which depend the appearance of an X-ray view. There are, on the whole, no adequate textbooks of radiology. Even in our days it is not fully realized by the great majority that if a change was not brought to appear in the examination, a further analysis of the views, however thorough it may be, will not be able to reveal any such change. This applies for example to an X-ray examination of the stomach as much as to such an examination of the bones. Some time ago, the author had to make a statement in his capacity of medical adviser to an insurance company regarding pictures presented of a wrist with possible navicular fracture. When communicating with the doc-

tor in question in order to discuss the pictures and inquire into the motives of the pronouncement that was made, the following comment was obtained: "The interpretation of an X-ray picture is generally very subjective. My interpretation is . . ." Such ideas must be regarded fundamentally wrong. In the medical field the radiological examination is perhaps the most objective means of examination. TILLIER says that the radiology is composed of two elements: (1) to perceive and (2) to understand what is perceived. Undoubtedly, this is right but one more important feature may be added: "to be able to bring forward what is there to be detected". When the examination is properly carried out, the interpretation of the pictures becomes almost a matter of subordinate importance since in that case the conclusions are easily drawn. To stress the point it may be said with some exaggeration that if there is uncertainty as to the presence of changes or not, in the examination of the picture material produced, then the examination has been unsatisfactorily performed. Difference of opinion may well arise as to the cause of a demonstrated change, but the investigation should always answer the question whether there is a change or not.

In X-ray diagnostics of the bones, the examination of the wrist represents one field where a defective technique may lead to serious consequences for the patient. The author, in his activity as adviser to insurance companies has learnt that there is generally much left to be desired in the X-ray examination and interpretation of the carpal scaphoid. In this connection MEEKISON has quoted ANDRÉ GIDE who says: ". . . Toutes choses sont dites déjà, mais comme personne n'écoute il faut toujours recommencer." This may be true with regard to the clinical and therapeutic aspects but in the author's opinion not where the normal anatomical aspect of the navicular bone is concerned and not as regards its radiological appearance. Experiences from the insurance casualties show that uncertainty and misjudgment essentially occur in two respects: (1) fracture is reported though non-existent or despite the fact that it cannot be confirmed on the basis of the picture material presented; (2) statements as to the age of the fracture are not based on a detailed analysis of the changes brought forward or with due consideration of the modifications of such changes with the increased age of the fracture.

The navicular bone is a part of the proximal row of bones of



Fig. 1. a) Os naviculare from the dorsal side after removal of the capsule. Note the region between the articular surfaces. b) Os naviculare seen from the side. Note the different levels of the proximal and distal parts and the cleft between them.

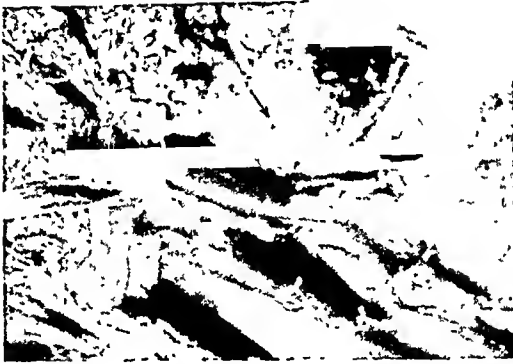


Fig. 2. Shows a view obliquely from the underside. The hook is seen to lift away the tendon of the flexor carpi radialis. The facet of the tubercle for the tendon is clearly visible (arrow).

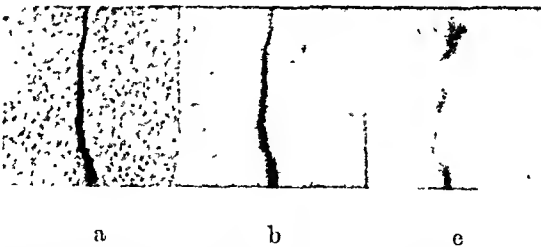


Fig. 3. Experimentally produced bone fracture, photographed with varied X-ray technique in order to demonstrate the importance of the technique for the appearance of a fracture: a) tube with a small focus and no intensifying screens, b) the same focus as in (a) + intensifying screens, c) larger focus + intensifying screens. The distance film—object—tube has not been changed.

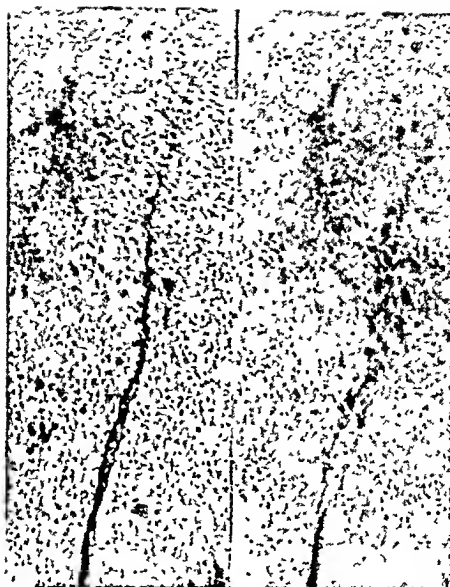


Fig. 4. The appearance of the same fracture as in Fig. 3:a) when the direction of the central ray coincides with the plane of the fracture, b) when it forms an angle of some degrees with the plane of the fracture.



Fig. 5. a) The navicular bone. No fracture. The fracturelike line (arrow) is caused by the cleft between the proximal and distal dorsal articular surfaces. b) Sclerotic zone between the two dorsal articular surfaces.

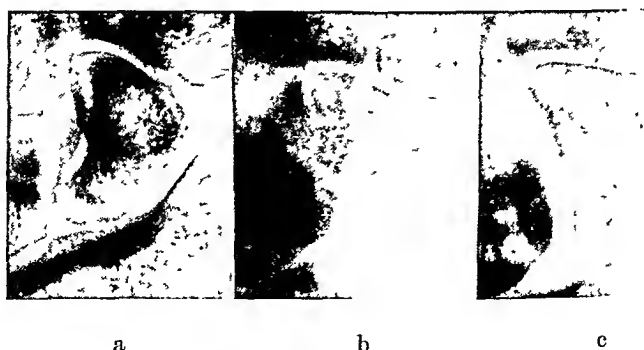


Fig. 6 a and b) No fracture visible. c) The fracture is clearly visible.

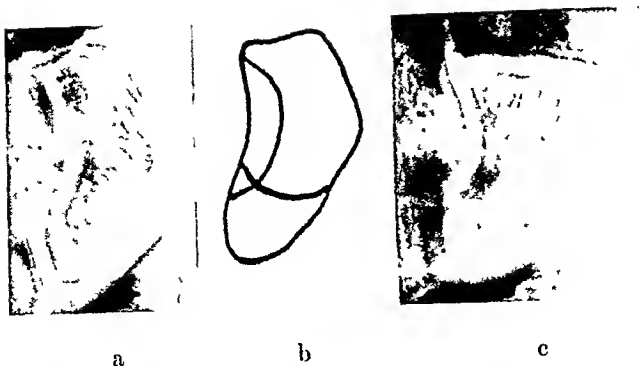


Fig. 7. Case 1. a) Fracture visible. b) Sketch to a). c) No distinctly fracture-line.



Fig. 8. Case 1. a) After 25 days. b) After 3 months.



Fig. 9. Case 1. a) After 8 months. b) After 1 year and 1 month. c) After 1 year and 7 $\frac{1}{2}$ months.

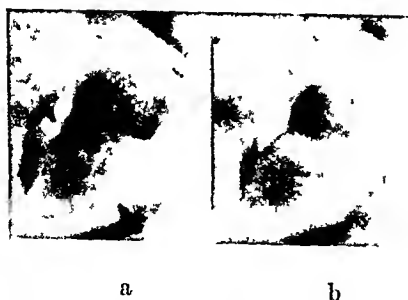


Fig. 10. Case 2. b taken 2 months later.

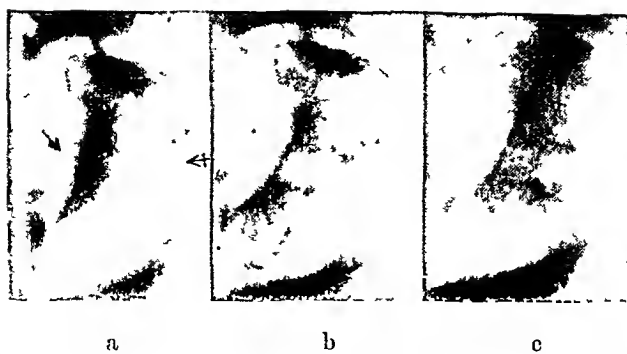


Fig. 11. Case 3. a) The cleft between the proximal and distal articular surfaces (\leftrightarrow). The suspected fracture \rightarrow . b) After $2\frac{1}{2}$ months. c) After 6 months.

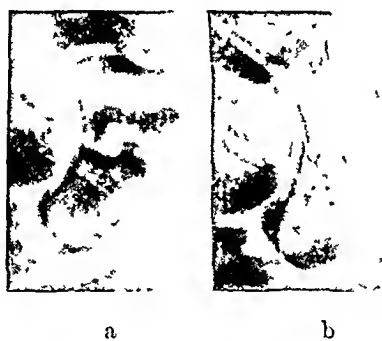


Fig. 12. Case 4. After $2\frac{1}{2}$ months.

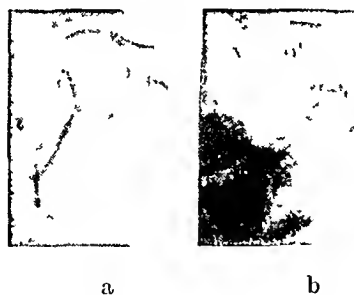


Fig. 13. Case 4. After 1 year $4\frac{1}{2}$ months.

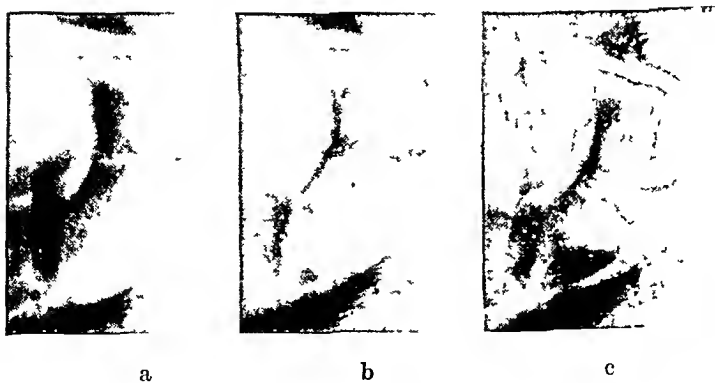


Fig. 14. Case 5. a) The same day as the trauma. b) $2\frac{1}{2}$ months later. c) After $4\frac{1}{2}$ months.



a

b

Fig. 15. Case 6. a) After 3 months. b) After 4 years.



a

b

c

Fig. 16. a) No fracture visible. b) The fracture clearly visible. c) Lateral picture. No fracture visible.

the wrist. The proximal part of the navicular bone is more dorsally situated than its distal part and the whole bone is generally described as comma-shaped. To the distal-volar side, the tubercle forms the bent, narrower end of the comma. Fig. 1 a shows the appearance of the bone from the dorsal side when the capsule as well as the ligaments attached to the superior surface of the navicular bone have been removed. As can be seen in the picture, the navicular bone has two dorsal articular surfaces, one towards the radius and one distal towards the multangular bones. Between these there is a narrow area, of a few millimeters width only, with ridges towards the two articular surfaces and in between a highly irregular and rough region forming a more or less sharp depression. In some cases, this section may form a deep, narrow and accentuated cleft. The ulnar-dorsal border (towards the capitate) has often one "creek", or several ones more or less accentuated. Observing the bone from the side (fig. 1 b), the sharp cleft can be seen to pass between the articular surfaces, but it can also be observed that there is a considerable difference of level between the proximal and the distal parts of the navicular bone in dorso-volar direction. For the rest it should only be mentioned here, with regard to the appearance of the navicular bone, that it has a concave articular surface against the capitate and a flat facet on the ulnar-proximal side for articulation with the lunate. There is no boundary, neither in the form of furrow or border, between these articular surfaces. Distally to the volar side lies the tubercle which generally seems to have a flattened surface for the tendon of flexor carpi radialis (Fig. 2). This has not been stated in the ordinary textbooks of anatomy and it may therefore be mentioned here, though it is of less radiological interest. In the radiological investigations, the fairly complicated structure of the navicular bone and its position are of great significance. On the ordinary frontal view (with dorso-volar beam direction) a shortened projection of the bone is obtained. In such a projection, the transverse fractures will lie in a plane not coinciding with the beam direction. The more extreme the radial flexion of the hand, the greater the extent of shortening of the bone. The more extreme the ulnar deflection is, the more will the navicular bone be "straightened", the projection will be less shortened and the chances will be greater that the plane of the fracture coincides with the beam direction. Unless dislocation has occurred, or diastasis in the fissure, the fracture will only be

clearly visualized when the plane of the fracture and the beam direction coincide. Because of the deep cleft to the dorsal side and, further, due to the terraced part clearly visible in Fig. 1, there can sometimes be observed on the frontal picture, since the X-rays have to pass through layers of different density, fracture-like lines *i. e.* more or less clearly outlined bands of lesser density. (Fig. 5 a, 11 a \rightarrow) From superposition of the distal part of the navicular bone on the distal margin of the articular surface towards the capitate it may also happen that fracture-like lines are produced. Experience gained from the casualties of the insurance companies has shown that such pictures, which are due to inadequate projections of the normal structure of the navicular bone, not seldom are mistaken for fissures. However, true fractures do not, as a rule, occur in the before described section between the dorsal articular surfaces. Mostly, they run at a sharp angle to this section and often they are perpendicular to it. They can often be observed to run to one of the mentioned "creeks" of the upper ulnar border. The most common region for the transverse fractures to appear is through that part of the navicular bone that corresponds to the distal part of the proximal articular surface, passing at a fairly sharp angle across the intermediary section and proceeding to one of the creeks. In some cases, especially when the cleft between the articular surfaces is shallow, the intermediary section which forms attachment for strong ligaments appears instead more dense than the environment (Fig. 5 b). This can in isolated cases of actual fracture cause misjudgment as regards the age of the fracture. It is not unusual, particularly with old people, that the structure of the bone in the intermediary section becomes irregularly sclerotic. A superprojection of the cortical sclerosis over the spongy substance can then give rise to pictures which create the erroneous impression that cysts are present in the navicular bone.

Since long it is known that frontal and lateral pictures alone do not suffice for establishing whether fracture is present or not. PERSCHL for example has stated (1938) that in addition two oblique projections are needed. The wrist is placed with its volar aspect on the cassette and the patient makes a fist so that his hand acquires a half dorsal flexion and is slightly abducted toward the ulnar side. The other projection is as follows: the hand with closed fingers is placed with its volar aspect on the cassette, then is supinated until its posterior aspect forms an

angle of 45 degrees with the plane of the film. The hand is in slight ulnar abduction. Other authors only state that the X-ray picture should be taken with the hand in extreme ulnar deviation, as this position brings out the bone completely (HENRY). On the other hand GRAZIANI considers 16 views to be necessary for an exhaustive study. MEEKISON points out that every distortion of the wrist should be X-rayed and that views at least in four projections should be produced, but he gives no detailed information as to the technique. WATSON-JONES recommends 3 projections of which the most important is "the oblique three quarter view". The same as was said before as regards photography and X-ray examinations can be applied to all the now mentioned projections. With the hand in intermediary position the common transverse fractures run in a plane, the dorsal part of which is more distally situated than the volar part. It will thus be necessary to place the wrist (which is easier as a rule than changing the beam direction) so that this plane coincides with the direction of the central ray. Partly, this can be achieved by deflecting the hand to the ulnar side, but since this is often not sufficient the radial part of the wrist should also be lifted. A sufficient ulnar flexion may be difficult to obtain if the patient suffers great pain but the procedure may be facilitated by taking the pictures, according to PERSCHL, with bent fingers. No general statement can be made as to the extent to which the radial part of the wrist should be lifted. This depends on the appearance of the bone in the actual case and, particularly, on the amount of ulnar deviation imposed upon the hand. Thus, in each separate case, a satisfactory projection can only be achieved by taking into consideration all the factors mentioned.

Views of a wrist are presented in Figs. 6 a and b. However thoroughly these views are studied ("interpreted") can no information be derived as to an eventual damage to the navicular bone. With the image in Fig. 6 c, on the contrary, which was taken on the same patient at the same occasion, no special procedure of "interpretation" is required. The fracture is clearly visible. In the case it was possible to impose upon the wrist an extreme ulnar flexion, which was sufficient to demonstrate the fracture. If a line of lesser density is seen in a certain projection, the investigation should continue with the object of determining its nature. If there is a fracture, it should be possible to get it produced free from such parts of the navicular bone that might

shade. To judge whether a loss dens zone is due to fracture or not, it will be necessary to produce views where the beam direction coincides with the plane of the fracture. Only on such pictures can an accurate analysis of the surfaces of the fracture be made and information be derived as to the age of the fracture and, all the more important, as to the occurrence of healing phenomena.

To illustrate the development of fractures of the navicular bone the following series of examinations may serve as examples.

Case 1. Male, aged 26. Injured on February 26th from getting the wrist into a squeeze. At the first examination a fracture across the proximal part of the navicular bone was demonstrated. In Fig. 7 a, the fracture is clearly visible. The view in Fig. 7 c, taken with the radial part of the wrist lifted, does not show the fracture distinctly enough to permit of diagnosis. The radial part of the wrist has been lifted too much. Since it is known beforehand where the damage is located, it is however possible to detect part of the fracture. The sclerotic zone between the articular surfaces can be observed. At the radial part of this sclerotic zone, a thin line can be observed but this is no indication of fracture, since it is located to the earlier described cleft (arrow). The view in Fig. 8 a was taken 25 days later. (The patient was not treated with plaster-of-Paris during the whole time of observation but did full-time work as an electrician.) This picture shows a wider fissure than before, due to decalcification of the environment. After a further 3 months this change is more pronounced (Fig. 8 b). The decalcification around the fracture has increased. The decalcified area is however now demarcated by a narrow sclerotic border zone. This sclerotic zone is even somewhat more marked after 4 months. The sclerosis in this case is due to new bone formation and on a view taken 8 months thereafter this newly formed bone (endosteal callus) can be observed to partly fill the fissure (Fig. 9 a). After one year and a month, the further progress of consolidation can be seen but there is still some part of the fissure to be observed, particularly to the radial side (Fig. 9 b). When one year and $7\frac{1}{2}$ months have passed there is no fissure to be detected (Fig. 9 c): the fracture is completely consolidated. WATSON-JONES has stated: fractures of the waist and of the proximal pole of the scaphoid never unite spontaneously. *This case indicates however that such a union might occur.*

Case 2. Male, aged 25. The typical development in a case of navicular fracture when the wrist has not been immobilized with plaster can also be followed in Fig. 10. The patient was injured in an automobile accident. According to the statement of the doctor, who attended to the patient at the first examination, no damage to the bones had occurred. A study of the view taken a few hours after the accident (Fig. 10 a) shows however a clearly visible fracture at the boundary between the proximal and intermediate third of the navicular bone. On account of

remaining pain, the patient was X-rayed two months later (Fig. 10 b), when resorption around the fracture was observed and also a beginning demarcation, by a faintly sclerotic border, of the resorption zone.

Case 3. Male, aged 25. Dislocated wrist. The view in Fig. 11 a was taken when the damage had occurred and it was stated that no fracture was visible. A narrow and less dense line can be seen but in a region which makes fracture improbable, since the cause is evidently to be found in the cleft between the proximal and distal articular surfaces. In addition, however, there is another less dense zone proximal to the afore mentioned at the dorso-ulnar margin (arrow). The cause of this zone cannot be established on the basis of the view produced, but it is probable that it is a fracture. In such cases, the examination should continue until certainty is obtained as regards the cause of the zones of lesser density. If the examination of this case had continued a correct diagnosis would have been possible. Two and a half months later, the navicular bone had the appearance shown in Fig. 11 b. The secondary changes are of similar character as those illustrated in the two preceding cases, *i. e.* there is a decalcified area around the fracture and a sclerosis surrounding the decalcification. The wrist was then immobilized with plaster and 6 months after the trauma, the major part of the fracture is united but to the ulnar side there is still some remnant of the fracture (Fig. 11 c).

The course of development of a not immobilized navicular fracture that does not unite is illustrated in the following series (Figs. 12—13).

Case 4. Female, aged 22. A student of the Gymnastics Central Institute. The patient fell and supported herself with the left wrist which became swollen. At the first examination, a barely visible thin fracture was observed. The wrist was not put into plaster. Some days after the trauma the patient was free from trouble but soon she had a return of trouble and, after several weeks when she was still not free from symptoms and suffered pains by extreme movements, she came back for consultation. At that time, $2\frac{1}{2}$ months after the trauma, the navicular bone had the appearance illustrated in Fig. 12 a. It would seem as if this picture were at variance with the two preceding cases and that the secondary changes in this case were more extreme, but this is not so. A very shortened view of the navicular bone is produced, *i. e.* the two fragments overlap to some extent. In this case the adequate projection (Fig. 12 b) (with the central ray coinciding with the plane of the fracture) shows the decalcification around the fracture which is demarcated by a narrow sclerotic zone. Hence the changes are not so extreme as could be supposed from the appearance of the preceding picture which was due to superposition. The progressive changes correspond to those demonstrated in the two preceding cases. The patient was still not put in plaster and she continued with her gymnastics training. The view in Fig. 13, taken about one year and $4\frac{1}{2}$ months after the trauma, shows the status at that time. The fracture did not unite. There is increased sclerosis around the fracture but no obliteration of the

fissure. The surfaces of the fragments have instead become smoothly rounded and have borders suggestive of cortical layers. A non-union (pseudo-arthritis) is established. However, the patient is without pains, feels no tenderness upon movements and is active as a gymnast. The mobility is alike in the left and the right wrist. *This case shows that some non-united navicular fractures do not produce clinical symptoms.*

Case 5. Male, aged 21. From the case demonstrated in Fig. 14 the view in Fig. 14 a, which was taken in connection with the trauma, shows a fracture of the navicular bone. There is some sclerosis around the fracture particularly towards the radial side, but this sclerosis cannot be ascribed to advanced age of the fracture but is the sclerotic zone normally appearing between the two articular surfaces. The main part of the fracture is located precisely to the region between the articular surfaces. The wrist was put into plaster. New bone formation started after $2\frac{1}{2}$ months (Fig. 14 b). In comparison with the cases which had not been treated with plaster, the decalcification around the fracture is considerably reduced and the restorative changes set in at an earlier stage. Already $4\frac{1}{2}$ months after the first examination the crack was mostly filled (Fig. 14 c).

As we know, the navicular fractures only unite with endosteal callus, appearing to fill the crack. The aspect of the fracture varies with the beam direction and great caution must be exercised when studying the stages of formation of the callus, which should only be done on technically successful pictures produced in accurate and appropriate projections. It may be difficult, in some cases, to determine whether the sclerosis arising around a fracture is a sign of beginning union or indicates the kind of sclerosis which occurs on the surfaces of the fracture when non-union is established. As a rule, however, the latter occurs at a considerably later stage — after several months — and is located to the very surface of the fracture, whereas the former arises at a distance from it but makes gradual progress through the decalcified area and finally fills out the fissure. When increased density of the bone around a fracture is observed to set in as early as in the case shown in Fig. 14 b, this is no indication of non-union but a sign of beginning consolidation. Has the new bone formation, however, a shape similar to this narrow and dense zone, it is almost always misinterpreted.

Case 6. Male, aged 17. In Figs. 15 another case is illustrated, the fracture of which did not unite. The appearance of the fracture some months after the trauma is demonstrated in Fig. 15 a. The navicular bone has the appearance typical of an untreated fracture. In Fig. 15 b the non-union is shown 4 years later. No arthritis deformans has occurred.

Whether arthrosis develops or not, in a wrist with navicular non-union, is probably chiefly dependent on the amount of strain to which it is subjected. Many people seem to have a non-union without symptoms and without producing any roentgenologically detectable signs of arthrosis even after several years. In other cases, arthrosis may develop at an earlier stage and usually in a way implying reduced thickness of the cartilage between the distal fragment of the navicular bone and the radial styloid process which latter is also gradually changed. The author has no experience of roentgenologically confirmed arthrosis which has been observed to appear within the first year following a trauma against a sound joint.

A study of the surfaces of the fracture, in views where the planes of the fracture are projected free of such skeletal parts that are liable to be superimposed, will always allow a differentiation between a non-union and a more recent fracture. With non-union there also occurs as a rule, on account of disturbances of nutritional nature, changes of the structure of the fragments — in a zone along the surfaces of the fracture or in large parts of the fragments. If these changes are small it may occasionally happen that difficulties arise for a differentiation from the very seldom occurring congenitally bipartite scaphoid. These questions cannot be discussed in detail in this connection, but reference is made to earlier works on the subject.

From clinical standpoint, the transverse fractures belong to the more important ones. Besides, there are cases where the tubercle has been broken off completely, or only parts of it. In such cases, the planes of the fractures cannot be visualized on frontal pictures. The radial part of the wrist must be lifted more or less from the cassette, sometimes to an extent which makes the projection almost a lateral one. Thus, also these fractures have characteristics that do not appear on conventional frontal and lateral pictures of the wrist. (Figs. 16 a—c.)

Summarizing with regard to the transverse fractures it may be concluded that the anatomical aspect of the navicular bone is such that fracture-like views can be produced in certain projections. With anatomical knowledge and familiarity with the examination technique it is however possible to differentiate between fractures and such structural changes that appear on the view as a consequence of the very particular aspect of the region between the dorsal articular surfaces. In about 14 days after a

fracture, a certain decalcification will be present around the crack, which in any case will be distinctly visible after 3 weeks and more certainly so if the patient has not been put in plaster in the meantime. The reason for the recommendations in the literature that a repeated X-ray examination should be made after some time, when clinical symptoms of a patient remain despite the fact that fracture was not demonstrated at the first examination, is thus to be found in the appearance of this decalcification, which makes it easier to detect the fracture. Whether such control examinations are necessary, or to what extent, will usually depend on the skill and efficiency with which the first examination was performed. After 2 months, on the average, or more surely after a further couple of weeks, restorative changes will be observed in the form of denser zones demarcating the decalcification. If the hand has been properly immobilized, the local decalcification will never be very extensive. On the whole, the endosteal callus formation will in that case develop more rapidly, but anyway, independent on whether the hand has been immobilized or not, the first demonstrable appearance of newly formed bone will occur at about the same time (after 2 months).

Summary.

The anatomy of the navicular bone is accounted for with respect to features of particular importance for the radiological examination. Descriptions are given of the usual stages of development of navicular fracture with examples from a number of cases that have been closely followed up.

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Late Results in Fractures of the Fore-arm in Children.

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In treatment of fractures of the fore-arm in children one must often put the question: is reduction necessary or not? From of old, we know that mal-united fractures show a spontaneous correction as time passes, and that this power is especially pronounced in growing individuals. There is, however, obviously a limit beyond which the potentialities of the bone for correction are not able to prevent permanent disability. Where does this border-line lie? The investigations done hitherto hardly suffice to answer this question and opinions thereon are not in agreement. It has, therefore, seemed to us that it would be of interest to review our own series with the question: what is the late result of a fracture sustained during childhood, that has united in a malposition?

This question may be put in all forms of fractures, but we have concentrated in the first place on the conditions in fracture of the fore-arm, these being so commonly occurrent. BEEKMAN and SULLIVAN (4) have investigated the frequency of various fractures in a series of 2,094 fractures in children under 13 years of age. In 75 percent the upper extremity was damaged and in 45 percent the radius was involved. Of the fractures of the fore-arm 82 percent were located to the distal third. Radius is thus the most commonly fractured bone in children and the injury in the great majority of cases is localized to its lower third.

In adults one distinguishes between fractures within the regions of the elbow and the wrist, and fractures of the shaft. Also in chil-

dren it is usually easy to define the first group, while on the other hand, it is more difficult to draw a border-line between the fractures of the wrist region on the one side and those of the shaft on the other. This is explained by the fact that the so-called typical radius fractures which are extremely common in adults and distinctly belong to the wrist region hardly exist in children. The fractures characteristic for children have a more proximal localization, frequently within the distal portion of the diaphysis. This has lead many authors (BLOUNT, SCHAEFER and JOHNSON (8), THORNEDIKE and DIMMLER (27), LEVINTHAL (17), and others) to prefer to discuss the fractures within the distal third of the fore-arm as an entity. MCKENNA (18) draws the limit to the distal fifth, as he had found that the fractures commonly are sited closely proximal to the upper margin of the pronator quadratus muscle, which runs straight across the lower fifth of the fore-arm. MASSART and CABOUAT (19) have drawn the borderline three fingers breadth above the wrist, which would be approximately correspondent to the distal fourth. Several other French authors, such as BERTRAND and JUDET (6), SALMON, BOUYALA and GREGOIRE (25) also consider the distal fourth to be an appropriate entity. EHALT (13) speaks of the carpal region without actually precising its extent. In our series it was found expedient to combine the fractures of the distal third in one group. In our follow-up examination we have excluded the fractures of olecranon and the radial head.

Our further division of the various types of fracture appears from the following outline:

- I: Wrist fractures = fractures within the distal third of the fore-arm.
 - a. epiphyseolyses
 - b. incomplete fractures
 - 1. torus fractures
 - 2. greenstick fractures
 - c. complete fractures.
- II: Shaft fractures
 - a. incomplete fractures
 - b. complete fractures.

As will appear from the outline we have attached less importance to whether both bones or only the one has been injured. From the therapeutic point of view this further subdivision is justified

but as our primary interest has been focused on the malunion as such, this division is of lesser importance. In this connection it should be pointed out that in lesions within the carpal region, radius practically always is affected (in MASSART and CABOUAT's (19) survey of 377 fractures, in all of the cases), frequently in conjunction with ulna. On the other hand, isolated ulna fractures are rare in this region, although they occasionally are seen higher up on ulna. Ulna-epiphyseal separations exclusively are hardly considered to occur.

"*Epiphyseal separation* is to be regarded as a fracture adjacent to the epiphyseal line but not actually through the epiphyseal disc" (WATSON-JONES (28)). The proliferating cartilage cells closest adjacent to the epiphysis (HAAS (15)) are not damaged hereby. Epiphyseal separation occurs about 4 times as often in boys as in girls (BERGENFELDT, 5). The beyond comparison most common localization is the lower portion of radius. The lesion is mainly seen in individuals in ages 12 to 14, while it is uncommon under 9 and over 17 years of age (BERGENFELDT, 5, VULLIET, 29, and others). The epiphysis is commonly displaced dorsally and somewhat radially and generally includes a small triangular corner from the margin of the metaphysis at which the dislocation takes place. HOLLAND (16) considers that there is always present an epiphyseolysis when such a fragment is detached. MASSART and CABOUAT (19) and also EHALT (13) make the diagnosis of epiphyseolysis in the presence of a tenderness restricted to the epiphysis, even though roentgenological signs are lacking. In the present series cases of this type have not been designated epiphyseolysis.

In approximately one-half of the cases (the different authors report very divergent figures), the epiphyseal separations are combined with fractures through the ulnar styloid process or through the ulnar diaphysis or with an ulnar epiphyseolysis. These complications are not of great importance notwithstanding that the avulsed ulnar styloid process usually does not heal (MASSART and CABOUAT, 20, AITKEN, 1). There is but rarely lasting pain or tenderness on the site of this lesion.

The *incomplete subperiosteal fractures* in the lower third of the fore-arm, typical for the ages of childhood and early adolescence, are grouped by many authors into the subdivisions 1: torus fractures (French "fractures par tassement") and 2: greenstick fractures (French "fractures en bois vert").

Torus fractures are mainly sited supra-epiphyseally, according to BURNHAM (12) about 2 cm. above the epiphyseal line. On the frontal aspect there is seen a slight bulging of the cortex; on the lateral view there is observed on one side a ridge on the outline (MOUCHET and MOUCHET (21)). There is no or only a slight deviation. Approximately every other case is combined with an ulna fracture, generally of the same type. GILLIES (14) points out the great frequency of these fractures.

Greenstick fractures have their site of predilection still further proximally and are often accompanied by an ulna fracture, at the same level. An angulation, preponderantly dorsal, belongs to the picture. The cortex is ruptured on the convex side but intact with exception of the angulation on the concave side (BOPPE, 9).

Complete fractures with not infrequently a total lack of contact between the fragments very commonly includes both bones at approximately the same level. The periosteum is often avulsed but this is not necessarily the condition for the arising of a marked dislocation (MÜLLER, 22). Especially in the French literature these severely dislocated fractures have been the subject of great interest and many authors (SALMON, BOUYALA and GREGOIRE, 25, BERTRAND and JUDET, 6, and others), consider them as a separate group. The fracture-line generally runs transversely 2 to 5 cm. above the wrist. The distal fragment is dislocated dorsally.

Shaft fractures. Since the most important supinators of the forearm are attached to its proximal third and the pronators to its middle third, it would be justifiable to group the shaft fractures with consideration to these facts. We have, however, refrained from this, for one reason because of the smallness of the series. We have considered it sufficient merely to distinguish between incomplete and complete fractures. Commonly both the radius and ulna are injured and then at approximately the same level, although more commonly than is the case in adults in only one of these bones (BLOUNT, SCHAEFER and JOHNSON, 8).

Treatment. In torus fractures and greenstick fractures without a pronounced displacement a simple plaster splint during 8 to 14 days is sufficient when the wrist is involved, and a week or so longer when the forearm is concerned. If, in a greenstick fracture, the angulation surpasses 10° , BLOUNT, SCHAEFER and JOHNSON (8) consider that reduction should be undertaken. The majority of authors do not mention any definite measurements as to when reduction should be resorted to. In reduction manoeuvres Mc

KENNA (18) recommends an overcorrection in order to compensate the tendency of the fragments towards redislocation. BEEKMAN and SULLIVAN (4) go still further and propose that the incomplete fractures be converted to complete fractures as these are considered to have less tendency towards secondary displacements. Hereby reduction becomes difficult.

The complete fractures and especially those with a considerable dislocation make far greater demands on the surgeon, both in the case of the wrist and the shaft fractures. Many authors, BAGLEY (3), BÖHLER (9), BOSWORTH (11), BLOUNT, SCHAEFER and JOHNSON (8), WHIPPLE and ST. JOHN (30) consider that manual reduction and plaster or eventual traction treatment always leads to the goal. According to these authors, operative methods should never be used, partly because of the danger of infection and also because of the retarded or even absent healing observed by some authors. MASSART and CABOUAT (19), NOVÉ-JOSSERAND (23) and WATSON-JONES (28) are less categorical. SOWLES (26) considers that too much time should not be lost before operation is decided upon, as it is much easier to obtain an exact position at early operation. THORNEDIKE and DIMMLER (27) and particularly BILLET (7) go still further, the latter author considering that it is a great mistake to assume that bloody reduction and osteosynthesis are to be contra-indicated in children. MÜLLER (22) operates all cases in which there is shortening and in which the periosteum may be assumed to be uninjured. In such cases it is impossible to reduce bloodlessly. Since medullary nailing in adults has become common practice it might have been expected that this also would be the case in children. This however, does not seem to be the case to any appreciable extent, possibly owing to BÖHLER'S (9) advice to the contrary. Our own experience of this method of treatment in grave fractures in children (ÖNNE, 24) has as yet been encouraging. Whichever method is used, however, it should be followed by a period of fixation of 6 to 8 weeks.

The *prognosis* for fractures in childhood is generally considered very favorable. Non-union hardly ever occurs. In regard to the epiphyseal separations according to AITKEN (1, 2), the worker having taken most interest in these injuries in recent years, the primary position may be nearly the poorest conceivable. A reconstruction of the bone still takes place, so that in the course of $1\frac{1}{2}$ to 3 years the epiphysis again has taken a normal position in relation to the diaphysis. This is also the case in adolescents up to the

middle of the second decade (the radial epiphysis in girls is estimated to be closed at age 15, in boys at age 17). The same author in these cases, however, often finds accelerated ossification of the epiphyseal cartilage with a certain retardation of growth, amounting to $\frac{1}{16}$ — $\frac{3}{8}$ inch ($1\frac{1}{2}$ —9 mm.). This shortening appears to lack clinical significance. MASSART and CABOUAT (20) came to very similar results. It is of interest to note that these authors were not able to show any relationship between the degree of severity of the primary injury and the late results. EHALT (13) has not observed any disturbances of growth in his series, and BÖHLER (9) agrees in this, on the condition that the reduction has been exact.

In torus fractures the prognosis is favorable to one-hundred per cent, as also in greenstick fractures without any appreciable dislocation.

The late results both in complete and incomplete fractures of the shaft and the wrist regions, that have healed in an angulation position, is more uncertain. BÖHLER (9) warns against angulation, and also against rotation, without going into further detail. McKENNA (18) and THORNEDIKE and DIMMLER (27) are largely in agreement with this opinion. Several French authors, among others MASSART and CABOUAT (19) and BILLET (7), are afraid of a pronounced angulation, which they consider rather to be augmented with growth. The majority of workers who are adverse to operation consider, on the other hand, that at least axis deviations of lesser degree are spontaneously adjusted with time. *In no instance is any approximate measure of the angle allowed reported.*

In lateral dislocation of $\frac{1}{2}$ to 1 bone breadth and also in shortening, the prognosis is considered favorable at least in the shaft region.

It has long been recognized that shaft fractures in children stimulate an accelerated longitudinal growth. AITKEN (1) considers this due to a hyperemia within the epiphyseal cartilage, induced by the callus mass. He considers the increase in longitudinal growth to be seen mostly in children under 12 years of age.

The Present Series.

Our personal series includes 126 re-examined fractures from the period 1935 to 1940, inclusive (6 years) from Kronprinsessan Lovisas Barnsjukhus. It would have been desirable to select a still earlier period, but it was found that the fracture series before the

period in question was too small and that the difficulties in tracing the patients increased considerably for every year. We have, on the other hand, not included cases of more recent date than 1940, in order to obtain an adequate period of observation. It is unfortunate that many of the older roentgenograms are not made in two planes at right angles. The lateral views especially are imperfect and in a couple of cases the projections are so oblique that there is no possibility of making a reliable evaluation of the angles. These cases have therefore been rejected.

We have classified the series into the following groups and have hereby permitted the radius fracture to be decisive in the wrist region:

I: Wrist fractures

1. epiphyseolyses
2. fractures united with less than 10° angulation
3. fractures united with at least 10° angulation.

II: Shaft fractures healed with at least 5° angulation.

That we in the last group have included fractures with as little as 5° angulation is due to the fact that an angulation of the shaft may be measured more accurately and that even a slight axis angulation hereby is more prominent.

It has been our aim to re-examine all patients except those of group 2, that has served as a control series and from which there only has been included about every third patient (the selection being made according to the facility of obtaining contact with the patients). Of 15 epiphyseolyses, 14 were followed-up; of wrist fracture cases with at least 10° angulation, 46 out of 48 were contacted (2 had moved abroad), and among the shaft fractures, 21 out of 22 were re-examined (1 patient was dead).

In the wrist region, the lateral displacement generally has been slight in comparison with that in the dorso-volar direction. If therefore the lateral view has been made rather obliquely a potential angulation will be diminished. In determination of the angulations we have in addition always measured on the low side. Far from all cases have been controlled during the entire period of healing. A minor secondary dislocation may have occurred after the last control with roentgen examination without having been discovered. Therefore the angulation reported in the series is to be considered as a minimum measurement.

At follow-up examination we have distinguished between subjective and objective symptoms. In the latter are included partly

clinical, partly roentgenologically verified residues. We have considered a case to have a residual defect if at clinical investigation there is found a limitation of movement of at least 15° in any direction or, if in comparing the roentgenograms from the right and the left side there is measured a deviation in the inclination of the radial surfaces, of at least 5° . This limit is according to our experience beyond the limits of normal variation. We have designated the cases with fractures of the shaft as mal-united when there has been a residual angulation or curvature of the shaft of at least 5° . Finally, we have also among the cases with residual defect included cases with pseudo-arthritis through the ulnar styloid process.

Epiphyseolyses.

The series includes 14 epiphyseolyses which is a comparatively small number. This is surely due to the fact that the upper age limit for admission to this hospital is usually 12 years. The ages ranged from 7 to 14 years, with an average of 11 years. The age at follow-up examination ranged from 15 to 26 years, the average being 20 years. In 9 cases there was radial epiphyseolysis only, 1 case was combined with ulnar epiphyseolysis, 1 case with fracture of the ulnar diaphysis and 3 cases with fracture of the ulnar styloid process. All but 2 of the cases were reduced.

Primary results. The greatest residual dislocation measured during the period of treatment was a dorsal dislocation of 3–4 millimeters and an angulation dorsally of 15° . In 2 cases control after reduction was lacking. Nothing remarkable was recorded during the period of healing.

At follow-up examination 8 out of the 14 cases were entirely free from symptoms subjectively as well as objectively. The remaining 6 cases had slight symptoms, the distribution of which appears from the following:

- 1) 1 case had subjective discomfort without objective symptoms. This patient had a combined radius-ulna-epiphyseolysis, and complained of fatigue of the wrist on exertion. Nothing remarkable was clinically demonstrable, even with X-ray, in spite of an earlier dorsal angulation of 15° .

- 2) 2 cases had both subjective and objective symptoms. One of the patients indicated pain at maximal supination. She had a pseudo-arthritis in the ulnar process, which may explain the dis-

comfort. This fracture was not demonstrable at the time of the accident. The other patient had occasional pain in the wrist. The distal portion of ulna projected dorsally in a conspicuous manner. Roentgen examination revealed a 1 centimeter large cyst in the lunate and a couple of smaller cysts in multangulum minus and the capitate. These changes were not present at the period of treatment. It is possible that the discomfort may be referred to these bone processes which in their turn may have a traumatic genesis. The pain may also be due to the broadened and unwieldy head of ulna. This deformity is in all certainty due to the ulna fracture, since this probably passed through the ulnar epiphyseal cartilage.

3) 3 cases lacked subjective symptoms but showed objective symptoms. In one patient, in which there had been no roentgenographic control since the reduction, there was a limitation of 10° of the dorsal flexion and of 20° of the volar flexion. Although this was the right arm of a dextral individual the fore-arm had a smaller circumference than that of the left side. The patient had not observed the limitation of movement but considered himself to be free from symptoms. The roentgenograms afforded no explanation of the limitation of movement. Two patients with pseudo-arthritis through the ulnar styloid process were free from symptoms.

No certain disturbances of growth have been established in any case of epiphyseolysis.

Fractures Healed with Less than 10° Angulation.

Out of the 45 fractures of 44 patients with an angulation not amounting to 10° the youngest age at the time of the injury was 1 year and the eldest was 13 years, the average age being 7 years. Correspondent figures at the time of the follow-up examination were 10 and 23 years, respectively, the average age being 16 years. The distribution of the fractures appears from the following tabulation:

Type of radius fracture	No ulna-injury	With fracture of ulnar styloid process	With incomplete ulna fracture	With complete ulna fracture	Total
Torus fractures	14 ¹	2	1	—	17
Greenstick fractures	10 ²	3	8	—	21
Complete fractures	3	—	1 ³	3	7

¹ 1 of the cases had had infraction 9 months previously.

² 1 of the cases had had torus fracture 4 years later.

³ This case had in addition had fracture of the ulnar styloid process.

None of the torus fractures has been reduced, but one-half of the greenstick fractures have been reduced, secondary dislocation occurring among these in 2 instances. Out of the 7 complete fractures 5 were reduced by manipulation and 2 by operative measures. In only one of these 2 cases was internal fixation with wires made, in the other this was unnecessary as the fragments interlocked securely.

Primary results of the treatment. No fracture has united with a greater lateral displacement than 4 to 5 millimeters. The course of healing has been uncomplicated.

At follow-up examination 34 out of the 45 fractures were free from symptoms, subjective as well as objective. The remaining 11 are distributed as follows:

1) No case with subjective symptoms alone.

2) 1 case showed both subjective and objective symptoms. This patient was a girl, 16 years old at the time of the follow-up, who at the age of 4 had had a complete radial fracture 2 centimeters above the carpal joint. On admission to the hospital the hand was in a typical silver-fork position; the fracture was immediately reduced and not until this was done were roentgenograms taken, revealing the absence of angulation and a radial displacement of 3 millimeters only. The ulnar styloid process was not visualized. The course of healing was normal. The patient reports, however, that since removal of the plaster splint the distal end of ulna has at marked supination been displaced volarly with a click, and with an ensuing depression dorsally. This has not been associated with pain or reduction of the gross strength, wherefore the patient never has sought advice for it, nor does she now desire any measures to be taken. Roentgenographically, it is seen that the ulnar styloid process is separated from ulna by a diastasis, barely 2 millimeters wide. At maximal supination there is a volar-ulnar subluxation of the ulna.

3) 10 cases lacked subjective symptoms although objective symptoms were present. Without the individuals in question being aware of this, there was thus measured on the injured side in one instance a limitation of supination of about 25°, in another case a 30° limitation of pronation and in a third case a 15° limitation of the radial deviation. In 2 cases the dorsal-volar-flexion was 15° and 20°, respectively, greater on the injured side! Roentgenograms of all of the cases showed nothing remarkable. — Out of the 6 initially diagnosed fractures of the ulnar styloid process 3

had healed with pseudo-arthritis. In addition there are 3 similar pseudo-arthroses, in which at the time of the fracture a potential fracture of the process was not visualized, as ossification had not as yet occurred. None of these pseudo-arthroses revealed any other manifestations at the follow-up examination.

On the roentgenograms it has been possible in many instances to make out the old fractures by the presence of a slight local bulging and possibly a very insignificant angulation. Only in 1 case — that of a 13-year-old Polish girl — was the angulation unchanged, but it did not amount to more than 5° .

All of the roentgenograms have been studied with consideration to disturbances of growth in the wrist. The relation between the distal ends of radius and ulna on both sides shows very small variation in the same individual, but varies considerably in different individuals. Only in 2 instances has the inequality in the length of both radius exceeded 2 millimeters, then being 3 and 4 millimeters respectively.

Fractures United with an Angulation of at Least 10° .

This group consists of 46 cases with ages at the time of the injury ranging from 1 to 12 years, with an average of 6 years. The distribution of the various forms of fracture appears from the following tabulation:

Type of radial fracture	Absence of ulna injury	With incomplete ulna fracture	With complete ulna fracture	With ulna epiphys-colysis	Total
Torus fractures	1	3	—	—	4
Greenstick fractures	18	10	—	1	29
Complete fractures	3	3	7	—	13

It is noteworthy that there at the time of the fracture in no instance was established fracture of the ulnar styloid process, while there at the follow-up examination were found 2 pseudo-arthroses.

As appears from the tabulation, greenstick fractures are the preponderant type. Many of these were reduced, but at least in 4 cases there occurred a secondary dislocation once or several times, which was difficult to correct. A conspicuous trend of the entire group is that several patients have not sought advice until after an interval of from 2 to 4 weeks. Attempts of reduction have then usually not led to any result. No case has been operated on.

Primary result of treatment in patients with slight lateral displacement. In 43 of the patients the principal axis angulation was in the dorsal-volar direction and the dislocation ad latus was in no instance more than 4 millimeters. In 3 cases, on the other hand, there was a lateral displacement of the breadth of the bone, and concomitantly the greatest angle was open radially. These 3 cases will be discussed separately.

If the above mentioned 43 fractures are grouped according to the degree of the angulation at the termination of treatment, the following tabulation is obtained:

Dislocation	10°	15°	20°	25°	30°	35°
Number of cases..	19	16	3	2	1	2

In 3 cases the angle was open volarly, the rest were open dorsally, a frequent simultaneously occurrent lateral deviation exceeded 10° in 1 case only, being 20°.

Follow-up examination of patients with slight lateral displacement. Out of these 43 patients 34 were entirely free from symptoms, subjectively as well as objectively. The remaining 9 cases have the following distribution:

1) 2 patients had subjective discomfort without objective changes. They complained of trivial pain or fatigue in the wrist at marked strain. The fractures had in these cases united with an angulation of 10° and 15°, respectively. Neither clinically nor roentgenologically was anything remarkable noted, wherefore the connection with the previous fractures may be considered rather questionable.

2) 1 youth had both subjective and objective symptoms. He had a certain sensation of discomfort at protracted supination and this movement was limited with 25°. The distal surface of the radial joint was in comparison with that of the opposite side angulated at least 30° dorsally (the initial angulation was only 20°), and the distal part of radius had in addition a curved angulation.

3) 6 patients lacked subjective symptoms, but showed objective symptoms. In 2 cases there was demonstrated a limitation of at least 15° in the mobility of the wrist. A boy with 15° dorsal angulation and some degrees of radial deviation showed 10 years later a 15° limitation of the radial abduction, and another young man, healed with 25° dorsal angulation, showed after 9 years a limitation of supination of 25°. It is noteworthy that in both of these cases there had twice occurred secondary dislocation, which on each

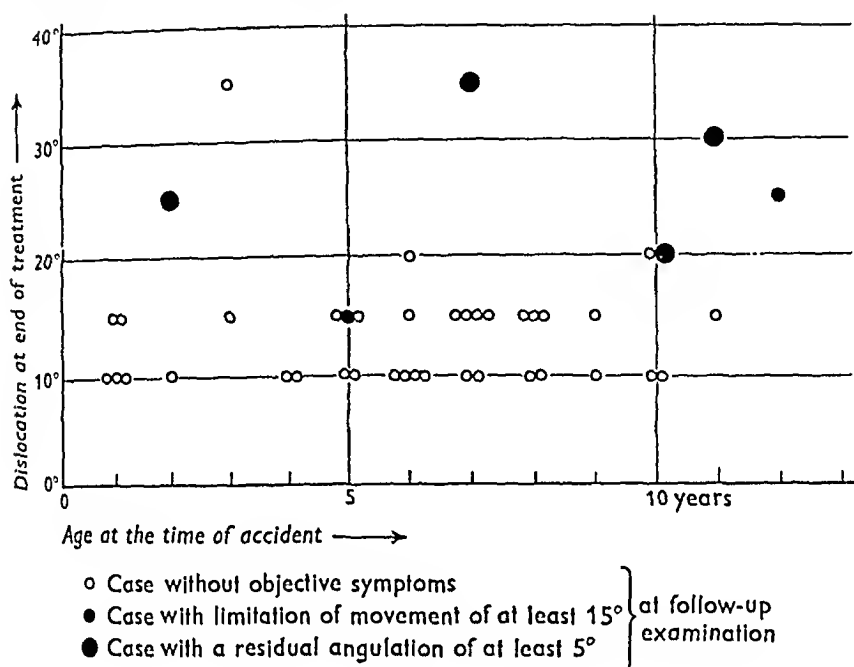


Fig. 3.

occasion was followed by attempts to reduction. — 3 cases had a final angulation amounting to 5° and 7°, one of these having an initial angulation dorsally of 35° (cf. Fig. 1). Figure 2 shows another case, that of a 3-year-old, who also initially had a similar malposition, but in whom this had been entirely obliterated. One of the patients in this third subdivision, as well as another patient, who did not show other symptoms, had pseudo-arthritis of the ulnar styloid process.

The result of the investigation of the 43 cases described above has for this group been depicted graphically in the chart above (fig. 3). Cases with limitation of movement of at least 15° are designated with small black dots, and with large black dots if there is a residual angulation of at least 5°. The remainder of the cases are characterized by circles, thus also those cases in which there has been slight subjective discomfort with absence of objective foundations. The cases are listed according to age on the horizontal axis, and according to the degree of the angulation at the termination of treatment on the vertical axis.

The object of the investigation and this diagram was the endeavour to establish for each age group that limit for the angulation beyond which permanent detriment is to be apprehended. It

appears from the diagram that this purpose hardly has been realized; this because the power of restitution has been beyond expectations. The series thus in nearly all of the cases falls below the borderline sought. From the prognostic viewpoint the residual angulation must be considered of most importance, mainly owing to the risk it may carry for arthritis deformans in the future.

Primary results of treatment in patients with lateral displacement of the breadth of the bone. There were 3 fractures that united with this dislocation of radius plus a shortening of 3 to 9 millimetres. The fracture line of radius was in all of the cases transverse, approximately on the junction between the second lowest and the lowest fourth. The fracture line through ulna was generally on the level, but in 2 instances it had an oblique course with a shortening of a couple of millimeters, in 1 case transversely with absence of shortening. As ulna was shortened to a lesser degree than radius there occurred in all 3 cases a mainly radially open angulation of 10° to 20° .

Follow-up examination of patients with a lateral displacement of the breadth of the bone gave the following results:

- 1) No patient had subjective symptoms alone.
- 2) No patient had subjective symptoms in association with objective symptoms.
- 3) On the other hand, 2 patients, although they considered themselves entirely cured, showed definite objective changes. Thus, 1 patient had a 25° limitation of pronation plus an angulation of radius of about 7° . The other patient had normal movement but an angulation in ulna, that, during the healing period of the fracture had been but negligible, had now become obviously accentuated. This was the patient in whom radius alone was shortened at the occasion of the fracture, which probably was the cause of this phenomenon. In the third case the site of the fracture could vaguely be made out on the roentgenogram and there was some degree of limitation of movement, although none of the findings were of such magnitude that they, according to our nomenclature, motivated the designation of residual defect.

Shaft Fractures.

The present series includes 21 uncomplicated fractures of the shaft united with an angulation of at least 5° . The age at the time of the injury ranged from 2 to 13 years, with an average of 6 years.

Correspondent figures at the follow-up examination were 11 and 26 years, with an average of 16 years.

15 children had fractured both bones of the fore-arm, 5 had fractured radius only and 1 had fractured ulna only. In 1 case the fractures were located in the proximal third of both bones, in 1 case in the upper third of radius and the middle third of ulna, in 3 other cases in the middle third of radius but the lower third of ulna. The remainder of the fractures were restricted to the middle third of the fore-arm.

The following tabulation shows the distributions of complete and incomplete fractures of radius and ulna:

	No ulna fracture	Incomplete ulna fracture	Complete ulna fracture	Total
No radius fracture	—	1	—	1
Incomplete radius fracture	4	7	1	12
Complete radius fracture	1	3	4	8

Two cases were operated on, in 1 case the fragments interlocked satisfactorily, in the other cases fixation was made with a bone graft (of "os purum").

Primary results of the treatment. If consideration is taken only to the maximal angulation at the last roentgen control and no weight is laid on either the direction of this angulation, or on whether radius or ulna is most angulated, the following is obtained:

Maximal angulation	5°	10°	15°	20°
Number of cases	4	7	3	7

The dislocation ad latus has commonly been slight. In one case there was a lateral displacement of the breadth of the bone in both radius and ulna with a shortening of 10 and 8 millimeters, respectively.

At follow-up examination 16 cases were entirely free from symptoms. The remaining 5 cases have the following distribution:

- 1) No case with subjective discomfort alone.¹
- 2) No case had both subjective and objective symptoms.
- 3) 5 cases, showed objective changes, although there was no subjective discomfort. These changes were roentgenological. All of the fractures of the shaft were not only subjectively, but also clinically entirely free from symptoms. The roentgenological changes in all of the 5 cases consist of a residual angulation or

¹ 2 patients did report that there was small difference between the two arms but that the discomfort was too slight to be worthy of mention.

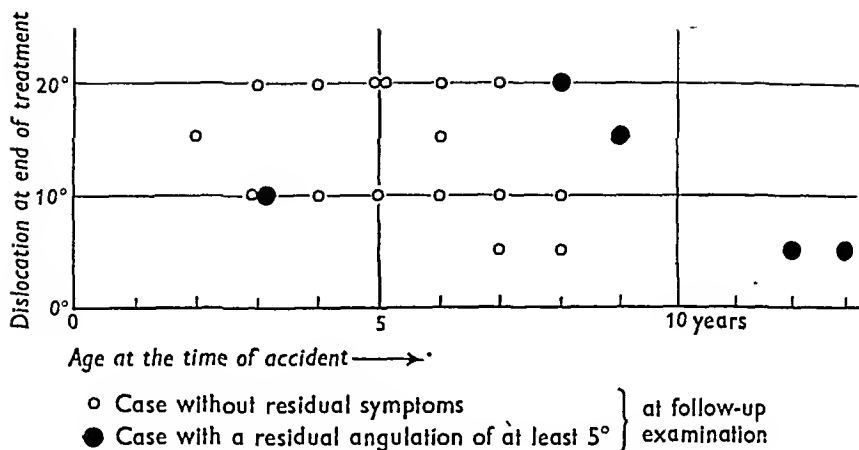


Fig. 4.

rather a curvature of between 5° and 10°. A slight although appreciable curvature was also observed in several cases. The following diagram (fig. 4) shows a classification of the 21 patients. The cases with a residual angulation of at least 5° are designated with black dots. The cases without residual symptoms are characterized by circles.

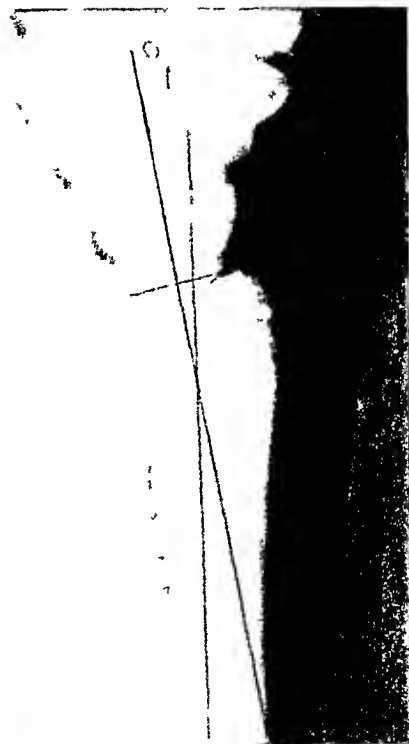
The children around the ages of 10 to 12 are unfortunately few in number, but nevertheless certain conclusions seem to be justifiable. During the first decade of life also the shafts of the fore-arms seem to have an excellent capacity of correcting angulations of at least up to 20° spontaneously during growth. After 10 years of age the cases have not shown such restitutorial powers, although the epiphyseal lines still exist.

Unfortunately, the entire fore-arm has been roentgen-examined only in fractures of the shaft, wherefore it has been possible in these cases only, to assess eventual disturbances of growth with any certainty. In 7 of these cases there are measured inequalities in length between the right and the left radius of 3 to 6 millimeters. But the right radius is longest in all instances although 2 out of the 7 are located in the left arm. There is in no instance any difference in the relationship between radius and ulna in the right and left wrist. These findings suggest that evaluations of disturbances of growth following fractures in children should be made very cautiously.

Our follow-up examination of shaft fractures united in a malposition of at least 5° has showed such insignificant residual symp-



A

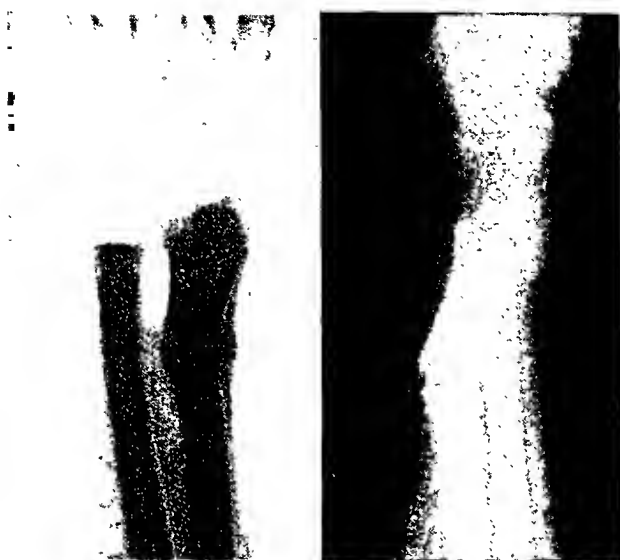


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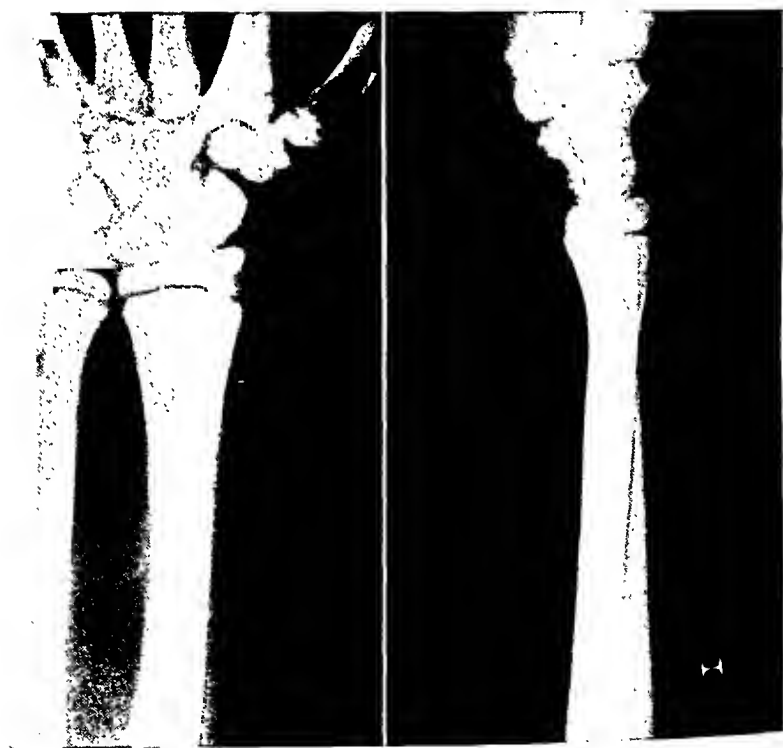
Fig. 1.

- A. Boy, 7 years old, at end of treatment.
- B. At follow-up examination, 10 years later.

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A.



B.

Fig. 2.

A. Boy, 3 years old, at end of treatment.
 B. At follow-up examination, 12 years later.

toms that it did not seem indicated to have also a control series of fractures united with a lesser or with no malposition.

Conclusions.

126 fractures of the fore-arm in children between 1 and 13 years of age have been re-examined with the object of ascertaining the final results of a fracture of the fore-arm sustained in childhood that has healed with a malposition.

Only 14 cases of *epiphyseolysis*, all of which had an initially rather insignificant dislocation, were re-examined. 8 of these were free from symptoms. One patient complained of a slight sensation of fatigue in the wrist, another patient had a moderate limitation of movement. These were the only symptoms that could be referred to the *epiphyseolysis*. 3 patients, however, had subjective or objective symptoms that rather must be considered due to a permanent injury of the ulnar styloid process. — The series is too small to allow of far-reaching conclusions. It does, however, substantiate the assertions of earlier authors, namely, that in *epiphyseolyses* the degree of dislocation is of subordinate importance for the prognosis.

Out of 45 fractures in the distal third of the fore-arm united with an angulation of less than 10° there was only 1 that showed residual subjective discomfort (due to a habitual ulna-subluxation in the inferior radius-ulnar joint). In 3 cases there was a residual defect in a rather insignificant limitation of mobility (15° — 30°).

Out of 43 fractures in the distal third of the fore-arm healed with an angulation of between 10° and 35° but without any major lateral displacement there was slight discomfort in 2 cases. 1 patient had subjective symptoms and a dorsal angulation of 30° . In 2 cases there was a slight limitation of movement and in 3 cases the only symptoms were a dorsal angulation of 5° to 7° . Our results show that during the first decade of life the bone within the lower third of the fore-arm in most cases possesses the power of correcting angulations of up to 20° to 25° . If the angulation is greater, however, there is reason to expect some defect in healing.

Three fractures had united with a lateral displacement of the breadth of the bone plus a shortening (3 to 9 mm.) and with a radial angulation of 10° to 20° . In 2 of these cases there were roentgenologically demonstrable curvatures exceeding 5° . In the third there was a slight limitation of movement, although not suffi-

ciently large to be termed residual detriment. It appears as though it would be desirable not to permit fractures within this region to heal with as marked a malposition as in these cases.

Out of 21 fractures in the proximal two-thirds of the fore-arm, with the exclusion of the elbow region, that healed with an angulation of 5° to 20° , there was no instance of subjective or clinically demonstrable symptoms. On the other hand 5 cases had residual angulation of between 5° and 10° correspondent to the site of the fracture, 4 out of these 5 cases belonged to the older age groups of this class of fracture (8 to 13 years). Our results show that during the first decade of life also the proximal two-thirds of the fore-arm have an excellent capacity in most cases of spontaneously correcting angulations of at least 20° , but that at the age of 10 years this power seems to diminish.

Our attitude towards operative reduction is as follows: if in a fracture of the fore-arm notwithstanding repeated manipulative attempts to reduction, there is a malposition exceeding 20° to 25° , operation is indicated, as well as in the presence of severely dislocated fractures within the distal third of the fore-arm, in which end-to-end contact of the fragment has not been obtained. We have not observed any detrimental sequelae whatsoever of the operative procedure, either in the 4 surgically treated cases of the present survey, or in others in whom intra-medullary nailing has been carried out (24).

Summary.

126 fractures of the fore-arm in children between 1 and 13 years of age have been re-examined. It is shown that during the first decade of life there usually is complete correction of angulation up to 20° to 25° , but above this age or this degree of malposition the power of correction is decreased, or is not capable of preventing residual detriment, respectively. In marked lateral displacement with shortening there is a comparatively large risk of defect healing, at least within the distal third of the fore-arm.

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On Pseudarthrosis of the Femoral Neck in Congenital Coxa Vara.

By

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A characteristic feature of congenital coxa vara, also and with more reason called infantile or developmental c. v., is a gap in the femoral neck, penetrable by Roentgen rays. This gap, which is perpendicular to the neck, is situated somewhat distally from the epiphyseal plate with which it sometimes connects in its upper part whilst the lower is ususally separated from the plate by a triangular fragment with bony structure. The typical gap is present only in children and young persons. On biopsy it has been found to be filled with cartilage and several authors emphasize that it is not to be confused with an ununited fracture. However it may be considered as a matter of fact that this part of the femoral neck is the weak point in which the bending occurs, which gives rise to the typical deformity, seen in adults, a neck bent downwards at an acute angle, a long, narrow and beaky trochanter and severe deformity of the head and acetabulum.

In this wellknown classical type the gap has disappeared giving place to a completely bony neck. It seems to be a common opinion that this is the rule, at least one can rather seldom find it mentioned in the recent literature, that the development may lead to a condition, very like an ununited fracture. However F. S. BABB, R. K. GHORMLEY and C. C. CHATTERTON emphasize that "adolescent and adult patients with untreated lesions exhibit what amounts to non-union of the femoral neck". Though this opinion seems to the writer to be too extreme it can not be denied that

the development of a pseudarthrosis of the neck is no rare occurrence. To judge from the fact, that it was established in 11 of the 18 cases of developmental coxa vara in adults, seen over a period of six years, it may to be believed to appear in at least half the cases.

Persons suffering from a coxa vara with pseudarthrosis are much more disabled than those in whom bony union has occurred, and they present a peculiar therapeutic problem, to which it seems to the writer that too little attention has been given.

In persons with still open epiphyseal junctions it may be difficult to decide whether the gap in the femoral neck, visible in the Roentgenogram, is a pseudarthrosis or not. Telescoping is not always reliable because it cannot be established, if there is a firm junction between the head and the remnants of the neck and the muscles are strong. Another symptom, which the writer has found very reliable in cases of traumatic pseudarthrosis in the neck, namely the fact that on rotating the whole leg the trochanter can be felt to rotate around the axis of the femur without moving upwards and downwards as in cases with a firm neck, may fail because the movements of the trochanter even in cases of coxa vara without pseudarthrosis are small, the distance between the head and the diaphysis being very short. In persons with closed epiphyseal junctions a gap in the neck always may be considered as a certain sign of a pseudarthrosis. In some cases, as in case 9, fig. 5, the displacement is so great, that any doubt seems excluded. A real pseudarthrosis was established at the operation in all of the writer's 11 cases.

Also the diagnosis of developmental coxa vara may in the writer's cases be regarded as established. The Roentgenogram was, besides the pseudarthrosis, quite typical. In addition there was in four cases (2, 4, 5, 9) a developmental coxa vara in the other hip. Though the clinical picture was strongly influenced by the pseudarthrosis, the mobility being greater than in most cases of coxa vara and the adduction contracture and the outward rotation less pronounced, the symptoms were typical enough to allow a fairly certain diagnosis, even without a Roentgenogram. In all cases a sign could be established, which the writer not has found described before but which seems to him to be almost pathognomonic in late stages of developmental coxa vara. This sign is that the greater trochanter, on flexion and extension of the hip, moves in a direction contrary to the movements of the

leg, owing to the fact that the trochanter in coxa vara is situated 5—10 cm higher than the axis of movement in the hipjoint, while in most other cases the axis of movement passes through the top of the diaphysis or above. The sign may be slightly positive in cases of congenital dislocation with very great displacement.

In all cases there was a severe insufficiency in the abductor muscles resulting in a very marked Trendelenburg test. The gait was limping and painful.

In 5 cases the limp was discovered when the patients started to walk and in 4 of them there was pain from the beginning. In the remaining 6 cases the limp was not observed before the age of 5—7 years. Two patients began to feel pain at the age of 6—7 years, two at 10—11 and three at 15—17 years.

In two cases (3 and 6) there was a history of trauma. The first one is said to have injured his hip when he was 6 years old, after which he limped but had no pain before at the age of 24, three months before the operation, he had a bicycle accident after which walking was very painful. In the hospital, where he received first aid, the diagnosis was fracture of the femoral neck. The second patient had been limping since she started to walk but had no pain before the age of 17. Eight weeks before admission walking became painful and after she fell, two weeks later and hurt her hip, weightbearing became impossible.

In both cases the Roentgenogram showed a typical developmental coxa vara with a pseudarthrosis, to a certainty older than the trauma. It seems probable, that the trauma had loosened a previously firm fibrous pseudarthrosis and thus caused the pain and the insufficiency.

As there seemed to be no chance to obtain any remarkable improvement by conservative means, an operation was found advisable in all cases. It is obvious that the first purpose of an operation had to be to obtain a stable and painless hip, but as all the patients were young with rather mobile hips it also seemed reasonable to perform the operation in such a manner, that the mobility was preserved. It may be mentioned that in all cases before the operation it was established by Roentgenographs in different positions, that mobility was present not only in the pseudarthrosis but also in the hip joint.

In the first 5 cases (1—5) it was decided to try to achieve the desired result by an intertrochanteric osteotomy, as suggested by

Table 2.

Mobility		Contracture	Pain	Limp	Use of cane	Former deformity	Gait improved	Full weight bearing	Time after operation when seen
Flexion	Rotation								
45°	0	adduction	yes	severe	out-door	unchanged	no	no	24 months
90°	traces	flexion 35	slight	slight	out-door	improved	yes	no	36 months
45°	traces	adduction	on strain	slight	no	improved	yes	no	23 months
60°	0	adduction	on strain	slight	no	improved	yes	no	39 months
0 30°	0 0	adduction abduction	yes yes	severe slight	yes yes	unchanged corrected	no yes	no no	8 months 13 months
0	0	abduction	no	no	no	corrected	yes	yes	8 months
20°	0	abduction	yes	slight	yes	corrected	yes	no	15 months
0	0	flexion 30	slight	slight	out-door	improved	yes	yes	6 months
90°	0	abduction	no	slight	no	improved	yes	yes	13 months
20°	25°	abduction	no	slight	no	corrected	yes	yes	17 months
traces	traces	abduction	yes	slight	yes	corrected	no	no	4 months

As a result of these unsatisfying results it was decided to change the method and to perform an operation, suggested by E. G. BRACKETT already in 1917 and in which the pseudarthrosis is fully exposed.

The skin was divided along a line beginning at the iliac crest, an inch behind the anterior iliac spine, then running in a distal direction 12—15 cm and finally curving dorsally. The muscles were divided in the space between the tensor fasciae and the gluteus medius. The fascia lata was cut well below the base of the trochanter. The neck was easily exposed and the pseudarthrosis opened. In all cases it was found to be widely communicating with the hip joint, in one case (2) there were no attachments between the head and the joint capsule, the head hanging

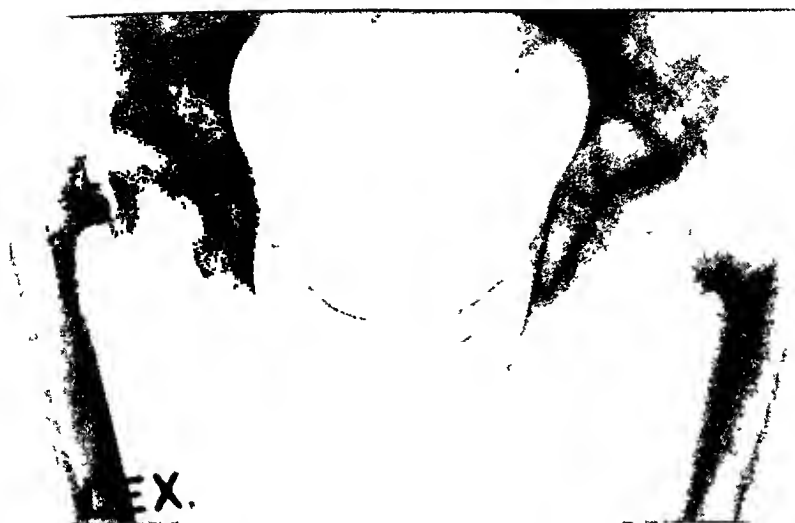


Fig. 1. Case 2. Male, 15 years. Coxa vara on both sides, pseudarthrosis on the right.



Fig. 2. Case 2. Three months after intertrochanteric osteotomy on both sides.



Fig. 3. Case 5. Female, 17 years. Coxa vara with pseudarthrosis on the right side.



Fig. 4. Case 5. Thirteen months after Brackett operation.



Fig. 5. Case 9. Female, 35 years. Coxa vara with pseudarthrosis on the left side, slight c. v. on the right.



Fig. 6. Case 9. Two months after Brackett operation, immediately after removal of the spica.



Fig. 7. Case 9. Eight months after Brackett operation. No weight bearing.



Fig. 8. Case 10. Male, 21 years. Coxa vara with pseudarthrosis on the right side.



Fig. 9. Case 10. Six months after Brackett operation.

solely by the ligamentum teres. After division of the trochanter 3—4 cm from the top, the end of the diaphysis was chiselled conic and the basis of the head gauged out. This turned out to be a difficult task because of the sclerotic, ivorylike condition of the bony plate at the basis of the head. Once, in case 11, the whole head broke in pieces on chiselling the plate in the above manner. In the last operated case (10) the writer used a drill for this purpose, which facilitated the procedure very much. Inside the plate was found fresh bleeding cancellous bone, in which the shaft was inserted in maximal abduction. Finally the trochanter was attached to the outer, freshened surface of the femoral shaft by a screw or a wire. The leg was immobilised in maximal abduction in a plaster of Paris spica for eight weeks and than slowly and carefully brought in to a normal position.

Deplorably it must be stated that neither did this operation, which BRACKETT suggested using in cases of traumatic pseudarthrosis and BARR in coxa vara, fulfill the writers hope of giving the patients a stable, painless and mobile hipjoint. In 3 cases the very slowly and carefully accomplished adduction led to a bending at the junction between the head and the end of the diaphysis as is shown in fig. 7. Though bony union finally occurred a marked coxa vara deformity still was present. In the remaining cases, in which bony union in the desired position was obtained, the price has been a nearly total loss of mobility in the joint. Three patients have returned to the hospital with the leg still in marked abduction and a very poor gait. In one of them the contracture could be corrected by gymnastics but in the others manipulation under anesthesia was necessary. The mobility improved somewhat on training but only one of them achieved a flexion of 90 degrees.

In case 11 also, in which the head was taken out and the operation accomplished as a Withman reconstruction, the result was a nearly stiff joint. The cartilage of the head was torn, showing evidence of arthrosis.

On discussing the results the question arises why the joint in all cases stiffened. The writer finds that the following factors have to be considered.

1:0. In developmental coxa vara in adults the joint is the site of a considerable arthrosis.

2:0. The operation has to be performed intraarticularly thus causing still more injury to the joint.

3:0. To bring the head and the diaphysis in to the correct

position it is necessary to put the leg in maximal abduction, which brings the adductor muscles into strong tension and causes the head to exert a heavy stress on the bottom of the acetabulum. The first mentioned factors it seems impossible to influence in any way. However the third, and probably most injurious factor, perhaps may be eliminated. The simplest way to diminish the tension and stress would be to shorten the diaphysis but to that the lesser trochanter puts a limit. The only possible method seems to be to accomplish an attachment of the head to the shaft, strong enough to allow an immediate adduction of the leg. Plates and screws would presumably not do but since the basal bony plate has been found to be very hard it seems possible to obtain a sufficient attachment by a stainless wire, conducted through boreholes in the femoral head and neck.

If this plan fails there only remains to try an arthroplasty with a Smith-Petersen mold after removing of the head.

Summary.

Of 18 adults with developmental coxa vara 11 exhibited a pseudarthrosis in the femoral neck. Five received a McMURRAY intertrochanteric osteotomy. Bony union was obtained in only three cases, correction of the previous deformity in none and full weightbearing in none. The range of flexion was 45—70 degrees. In six cases, including one of the abovementioned, who was operated twice, a BRACKETT operation was performed. Bony union occurred in five, full correction of the deformity in four, improvement in two. Full weightbearing was obtained in three cases, remarkable improvement of the gait in five. In contrast the mobility of the hip in five cases was very poor from 0 to 40 degrees. The writer discusses the reason for this failure and supposes that it may depend on the heavy stress, which will be exerted on the joint because of the extreme abduction position, necessary in the after-care. Probably this can be avoided by attaching the head to the diaphysis by a wire, which may be possible because of the ivorylike condition of the basis of the head and allow after-care in the normal position.

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Treatment of Infected Bone Defects with Cancellous Bone-Chip Grafts.

By

KARL-ERIK HOGEMAN.

The principle for surgical treatment of any infected focus in the organism is the radical removal of all dead and infected tissue and thereafter the elimination of the resulting tissue defect by means of suitable measures. In the application of this principle to infected cavities and defects in the bones, the surgeon is faced with especial problems. The radical cleansing of the infected focus does not in itself present any particular difficulties, but the defect thus created requires specific treatment in order to provide possibilities for healing. Many methods have been devised to achieve this. One that is well known is to convert the defect into a broad open channel which is then left for secondary healing (ESMARCH). The majority of methods aim at filling the bone defect with autogenetic material or other non-irritative substances and thus to prevent recidivation of the infection. Examples of these methods are obliteration by osteoplastic operations on the cavity walls (BIER; AF SCHULTÉN), the implantation of a well-nourished muscle flap (STOLZ; FRANGENHEIM; AF SCHULTÉN), or a pedicled skin flap (NEUBER; MOSKOWICZ), filling of the cavity with fat (MAKKAS; CHAPUT; KRABEL), plaster of Paris (OEHLCKER; NYSTRÖM; EDBERG; NIELSEN), vaseline (GERSUNY; LÖHR), wax and paraffin (PAYR), iodoform (MOSETIG-MOORHOF), sulphonamide paste (TUOMIKOSKI), sulphathiazole and penicillin powder (PALMER), etc. A number of these techniques have a limited field of use, *e. g.* that of ESMARCH, which is not suitable for the treatment of infected cavities in the epiphyses. Others are directly

unsuitable, *e. g.* the implantation of fat. None of the forementioned methods of filling have proved satisfactory in the long run in respect of recurrences.

A common factor in all the forementioned therapeutic methods is that the bone defect occurring as a result of the radical operation persists, at any rate for a long time after the end of treatment, thus creating a site of less resistance with the risk of re-infection. Moreover, in some cases the radical excenteration of the focus in the bone causes such a loss of substance that the strength of the bone is considerably diminished or even gives rise to a break in the continuity.

Many attempts have been made earlier at filling infected bone defects with bone grafts but without any success. The collected experience of these experiments has shown that bone grafting on an infected bed is doomed *a priori* to failure and such a measure has been considered as a real error. This opinion has persisted even after the introduction of chemotherapy and of penicillin. The American orthopaedic surgeon DICKSON stated in 1944: "... a surgical bone graft should not be attempted in the presence of active infection even if low grade. An occasional success does not justify the risk of almost certain failure to be anticipated. ... Placing a bone graft in an infected area, therefore, must be characterized as surgically unsound and a violation of the principles of bone graft surgery." NIELSEN (1944) wrote, concerning the treatment of infected bone cavities: "*If the cavity is infected, living transplant cannot be used.*" It nevertheless appears that this opinion must be modified against the background of the last four years' experience of cancellous bone-chip grafting.

Reports of a number of *experimental investigations of cancellous bone as grafting material* have been published. OLLIER (1867) already attached importance to the cells in the marrow spaces of the spongy bone for the survival of the bone graft, and experimental transplantations with substantia spongiosa (AXHAUSEN 1907; CHIARI 1912; MIYAUCHI 1915) indicated that a large number of cells in these transplants survived. On the basis of his own investigations and those of other workers, LEXER (1924) raised the question of why a compact bone graft implanted in the soft tissue or in the substantia spongiosa is changed into spongy bone. He came to the conclusion that the more rapidly a bone graft is nourished, the greater the number of osteoblasts that will survive and be capable of function and the more rapidly do the bone-

forming properties of the. ngrowing granulation tissue counteract their resorptive properties. In a large experimental investigation on the dog, MATTI (1931) found that in free transplantation of cancellous bone the main mass of bone survived provided that the graft was not of excessive size but could rapidly become vascularized and that the bed was satisfactory from a circulatory aspect. GALLIE (1931) came to the same conclusions. He found that a bone graft from the crest of the ilium or the ribs resulted in more satisfactory bone proliferation owing to the high content of spongy bone. The same writer found, purely experimentally, that crushed cancellous bone gave a better new formation of bone than a block of cancellous bone under otherwise identical experimental conditions. He attributed this to the fact that the crushing of the bone caused an increased number of cell layers to achieve contact with the primary lymph circulation and thus to survive, after which the blood vessels of the granulation tissue could easily penetrate the spongy transplant and ensure continued nutrition. GHORMLEY and STRUCK (1934) compared the osteogenetic capacity in various types of bone grafts. Their results appear to indicate that cancellous bone unites considerably more rapidly than cortical bone, and signs of calcification are visible on the radiogram within three months.

CAMPBELL (1939) pointed out on the basis of his own investigations that cancellous bone is superior to all other bone grafts from an osteogenetic viewpoint. His opinion was endorsed by GHORMLEY (1942) who stated that this property of the cancellous bone is due to the fact that its lattice-like structure allows a rapid invasion of granulation tissue with appreciably faster revascularization than in the case of compact bone. Further support for this theory was given by ABBOTT et al. (1947) in their report of an extensive experimental study. They pointed out that mature bony elements once transplanted do not, for the most part, survive, whether they be derived from cancellous or compact bone. They constitute a mass that sooner or later will be replaced by that process known as creeping substitution. The only element in a transplant that survives and has osteogenetic properties is the cells in the so-called endosteal layer. In a cortical transplant this layer is found to a very limited extent or not at all, whereas in cancellous bone it is present in large quantities as a layer surrounding each trabecula. In contradistinction to compact bone, the numerous marrow spaces in cancellous bone afford a many-branched channel system

for the invasion of new vessels, by which means the cells of the endosteum rapidly come into contact with a vascular bed. This makes possible not only their survival but also early proliferation and establishment of new bone. The same writers also pointed out that there is a qualitative difference between cancellous bone with its marrow rich in fat and that in which the red bone marrow predominates. Fat has an inhibitory effect on the formation of the vascular granulation tissue, and spongy bone from the crest of the ilium or the epiphyseal ends of the long bones were therefore recommended as transplantation material.

HIGGS (1946) found in a radiological study that the time for consolidation after transplantation in pseudarthrosis in the long bones is reduced by the use of cancellous bone. He found consolidation after 16—22 weeks in the case of cortical transplants and after 8—14 weeks with cancellous bone grafts. Contrary to the unanimous opinions of the forementioned writers, HELLSTADIUS (1944) believed, on the basis of animal experiments, that cancellous bone does not possess greater osteogenetic properties than cortical bone, but rather the contrary. By means of the implantation of cortical and cancellous bone chips under similar conditions in artificial defects in the diaphysis of the radius in animals, he found that the new formation of bone in the cancellous chips took place more slowly and less abundantly and that the differentiation of the marrow space and of the cortex required more time than on the side on which the compact chips had been transplanted. Moreover, in certain cases the periosteal soft tissue showed some tendency to grow between the cancellous chips. In implantation of cancellous and compact bone in the muscles HELLSTADIUS also found that after three weeks there was no osteogenetic difference between the two types of grafts; in the spongy grafts there was no or only sparse new formation of bone in the closed marrow spaces and no living cells were found at that site.

Reports of clinical experiences of cancellous bone-grafting have been published by a number of writers. Already in 1920 ELOESSER made the observation that with the use of a piece of rib as a graft he found it considerably more resistant to infection than the usual compact bone graft. However, MATTI (1929) appears to have been the first to use cancellous bone with the object of stimulating osteogenesis in non-union of bone. He emphasized that spongy bone was superior as grafting material and that its osteogenetic capacity was further increased by dividing the bone into small

chips. In operations for pseudarthrosis he recommended both cancellous and compact bone chips for filling of the defect. In a later publication (1936) the same writer reported that with the use of this method he had obtained healing in three cases of infected pseudarthrosis, the main part of the chips having healed in with the aid of daily irrigation with rivanol. These publications did not, however, arouse any widespread interest. It was only during World War II that MOWLEM (1942) started to use cancellous bone for the reconstruction of defects in the skeletal bones of the face and cheeks. He assumed that a division of the cancellous bone into small chips would still more facilitate early vascularization of the grafts and permit their survival. The results of his experiments were very encouraging. The method rapidly became increasingly widely used in Anglo-American war surgery and today a large number of reports bear witness to the fact that cancellous bone chips are the sovereign grafting material for the stimulation of new formation of bone.

Clinical experiences of cancellous bone-chip grafts in *infected bone defects* are of main interest as regards the scope of the present paper. MOWLEM found in his transplantation experiments that a slight infection did not cause loss of the chips and in his publications (1944 and 1945) he reported among 85 cases of bone-chip grafting 11 in which the chips were implanted in infected bone defects in the tibia, the mandible or the skull. In all the 11 cases there was primary healing and new formation of both cortical and spongy bone. These experiences were fully confirmed by COLEMAN et al. (1946) who in a series of 52 infected bone defects treated in the same way as MOWLEM's cases, obtained primary healing in 92 per cent with obliteration of the bone defects by new formed bone; in four cases the results were unsatisfactory owing to remaining infection and loss of all grafts. During an observation period of 14 months COLEMAN et al. were able, by means of frequent radiological examinations, to note a rapid formation of new bone in the grafts with formation of cortical bone. All the cases treated were given penicillin intramuscularly before the operation and penicillin-sulfathiazole powder was sprinkled over the grafts. In accordance with MOWLEM's method grafts were taken from the anterior portion of the iliac crest and cut into small chips with removal of *all* cortical bone. This procedure is essential since cortical bone has less resistance to infection. The writers illustrated their statement with the report of a case in which a number of



Fig. 3. Case 5. Before operation.



Fig. 4. Case 5. 16 months after operation.



Fig. 5. Case 6. Before operation.



Fig. 6. Case 6. 15 months after operation.



Fig. 7. Case 7. Before operation.



Fig. 8. Case 7. 13 months after operation.



Fig. 9. Case 10. Before operation.



Fig. 10. Case 10. 10 months after operation.

cortical chips happened to be included. These were soon expelled whereas the cancellous chips remained and healed in. Primary suture without drainage was used in every case. Bacterial analysis of the cases showed considerable mixed infection (Staph. albus and aureus, Proteus, Diphtheroid, Pyocyaneus and Coli bac., Streptococcus and others) in a large percentage, but purer cultures of Staphylococci were also represented. *Of particular interest are the eight cases in which necrosis occurred in the skin flap used for covering the transplantation area. After the necrosis had cleared up, the underlying cancellous grafts were exposed. Sequestrum formation did not, however, take place but the grafts were gradually covered by granulation tissue and healed in.* None of the patients showed signs of relapse during the observation period. PRIGGE (1946) reported equally satisfactory results with cancellous bone chips in a series of 20 cases. He also emphasized the importance of carefully freeing the chips from all cortical bone and illustrated this with an account of two cases in which cortical chips had been included in the grafts. He was able to note how they gave rise to suppuration and became sequestered, whereas the implanted spongy chips in the same graft bed had a vital appearance and bled freely on trauma. ABBOTT et al. (1947) in addition to experimental advice, reported their clinical experiences of cancellous bone chips in infected bone defects, when primary healing with obliteration of the defects was obtained within six months in every instance. RHINELANDER and STARR (according to ABBOTT) had the same successful experiences and they also pointed out the importance of using chips of cancellous bone only, since cortical bone chips uniformly sequesterate.

KELLY (1946) was of an entirely opposite opinion regarding the value of cancellous bone chips for transplantation into infected bone defects. Owing to his own lack of success with this method, he stated that he preferred a carefully planned tubed pedicled skin-graft bearing a large amount of fat for the filling of the defect which he nevertheless considered should first be converted into a non-infected cavity through the application of split-skin grafts, a method also preferred by KNIGHT and WOOD (1945) and by ROBERTSON and BARRON (1946). KELLY, however, only mentioned that he used "iliac chips" and gave no detailed account of his operating technique, for which reason little importance can be attached to his statements.

The Writer's Material.

The writer's material consists of 11 cases of infected bone defects, treated at the Surgical Department of Serafimerlasarettet between October 1946 and June 1948. All the cases underwent regular follow-up examinations. The distribution of the material in respect of the *localization of the focus of infection* is as follows:

Humerus	1
Tibia	10

In seven of the cases there was osteomyelitis of sub-acute or chronic character following a compound fracture of the tibia. The remaining four cases consisted of Brodie's abscesses or residual cavities following radical operations for chronic osteomyelitis.

From a *histological* and *bacteriological* point of view the material is unfortunately incomplete. Thus, histological and bacteriological analyses are lacking in four cases although, clinically, osteomyelitis was present in every instance and an open fistula in three cases. The diagnosis was verified microscopically as chronic osteomyelitis in seven cases. The bacteriological culture revealed Paratyphus B in one case, Staphylococcus in five cases and in one the culture was negative.

The period during which the patients were followed up after the operation varies between six months and somewhat more than two years, with the main part of the cases distributed between one to one and a half years.

Operative treatment consisted of radical removal of all infected and scar-tissue and of excavation of the bone defect so that healthy, bleeding bone was exposed everywhere. The defect was then entirely filled with cancellous chips, approximately one square centimetre in area and 1—3 mm thick and carefully freed from all cortical bone. The chips were not closely packed together. When the area had been irrigated with penicillin solution, the soft parts were sutured primarily over it. In a few cases excision of the scar-tissue resulted in such an extensive defect in the soft parts that primary covering could only be accomplished with the help of one or two pedicled flaps from the surroundings.

In all our cases cancellous bone from the iliac crest was used. It is particularly two areas within the iliac crest that contain plentiful cancellous bone (Fig. 1), one in the anterior part and one in the posterior, the latter containing the largest amount. It was

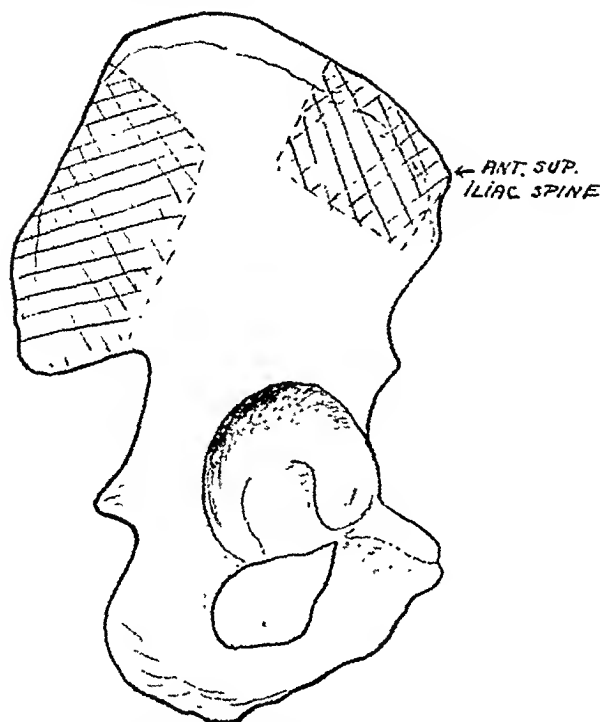


Fig. 1. Diagram showing the two areas within the iliac crest containing plentiful cancellous bone.

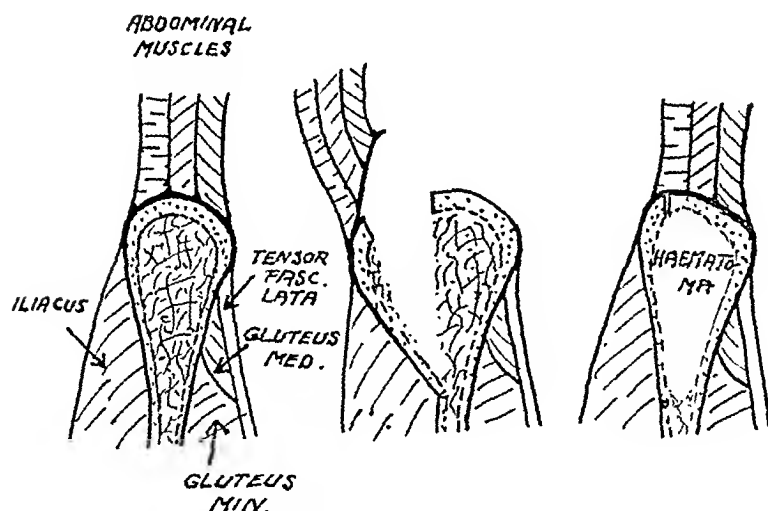


Fig. 2. Diagram of operative procedure for obtaining cancellous bone from the iliac crest.

possible in every case to obtain sufficient bone from the anterior part of the iliac crest which is technically easier to reach. After dissecting free the crista and detaching the muscle insertions and the periosteum together, the inner cortical lamella of the crista was

lowered towards the interior in a continuous piece. It was then easy to cut out the exposed spongy bone in large pieces with the aid of a gouge. When sufficient bone had been obtained, the inner cortical lamella was returned to its original position in order to prevent the collection of large haematoma and the muscles fixed in their normal position with periosteal sutures. Drains were not used (Fig. 2).

Post-operatively, penicillin was administered intramuscularly to seven of the patients. In three cases the temperature rose to 39° C or above on the first or second day after the operation, but in the remaining cases the highest temperature varied between 38°—38°.4 C. No exacerbation of the infection was noted in any instance. No haematoma nor infection occurred in the area of operation on the iliac crest.

Brief Case-Reports.

Case 1. 2684/46. Aged 35 years. *Chronic osteomyelitis following compound fracture of the tibia* in 1944. Operation, October 1946: Radical excavation + implantation of bone chips + covering with pedicled flap. Post-operative penicillin therapy. Highest temperature after operation 38.2° C. Necrosis in the flap with exposure of the transplantation bed. No sequestrum formation of the chips which 4 weeks after the operation were entirely covered by granulations. November 1946, covering of the skin defect with split-skin grafts. Discharged healed.

Follow-up, December 1948: Healed since discharge. Free from discomforts, working full-time. Skin grafts well healed. No fistula nor ulceration. X-ray examination: defect in the tibia entirely filled with new formation of bone. Left hip: well healed scar, no hernia.

Case 2. 593/47. Aged 71 years. *Chronic osteomyelitis in the humerus* for the past 50 years, operated on repeatedly, most recently in 1946. Persistent residual cavity in the upper epiphysis with fistula. Operation, March 1947: Radical excavation + implantation of bone chips + primary suture. Highest temperature after operation 38.4° C. Primary healing. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Paratyphus B.

Follow-up, December 1948: Following discharge from hospital, healing in the upper part of the humerus but re-operated on in April 1948 for recidivation in the lower epiphysis of the humerus. Scar well healed in the upper part of the humerus and no tenderness. X-ray examination: defect in the upper epiphysis entirely filled with bone. Right hip: well healed scar, no hernia.

Case 3. 2948/46. Aged 29 years. *Osteomyelitis in compound fracture of the tibia.* Operation, March 1947: Radical excavation + implantation of bone chips + intramedullary nailing according to Küntscher's meth-

od + primary suture. Highest temperature after operation 38.3° C. Primary healing. Küntscher nail extracted after consolidation in the autumn of 1947.

Follow-up, December 1948: Healed since discharge. Free from discomforts, working full-time. Well healed scar, no tenderness. X-ray examination: fracture consolidated in good position. Right hip: well healed scar, no hernia.

Case 4. 1556/47. Aged 56 years. *Osteomyelitis after compound fracture of the tibia* in 1945, with persisting fistula. *Operation*, August 1947: Radical excavation + implantation of bone chips + primary covering with pedicled flap. Highest temperature after operation 38.2° C. Necrosis in the flap with exposure of the chips. No sequestrum formation but 4 weeks later the chips are entirely covered with granulation tissue. October 1947 covering of the skin defect with a pedicled flap. Discharged from hospital healed.

Follow-up (questionnaire), December 1948: Still healed, doing full-time work. No discomforts. Examined in August 1948 by the writer. Flap then well healed in. X-ray examination: defect obliterated by new bone. Right hip: well healed scar, no hernia.

Case 5. 704/47. Aged 61 years. *Osteomyelitis in compound fracture of the tibia*, primarily treated with osteosynthesis in March 1947 (Fig. 3). *Operation*, August 1947: Radical excavation + implantation of bone chips + primary suture. Post-operative penicillin therapy. Highest temperature after operation 38.4° C. Rupture of the wound with exposure of the chips. Secondary healing without sequestrum formation of the chips. Discharged from hospital with plaster cast for out-patient treatment, healed.

Follow-up, December 1948: Doing full-time work but moderate swelling of the leg. No pain. Skin over fracture area well nourished, healed. X-ray examination: fracture consolidated, filled with strong, newly formed bone (Fig. 4.). Right hip: well healed scar, no hernia.

Case 6. 2052/47. Aged 24 years. *Osteomyelitis after compound fracture of the tibia* in 1945 with persisting fistula (Fig. 5). *Operation*, September 1947: Radical excavation + implantation of bone chips + primary covering with two one week earlier delayed pedicled flaps. Post-operative penicillin therapy. Highest temperature after operation 39° C. Necrosis in one flap with exposure of the transplantation area. After 4 weeks, with no loss of the chips, the defect in the skin was filled with granulation tissue and covering with split-skin grafts took completely. Discharged as healed. Microscopic examination: chronic osteomyelitis. Bacteriological culture: no growth.

Follow-up, December 1948: Healed after discharge from hospital. Walks unhindered. Grafts well healed in with satisfactory circulation. X-ray examination: defect entirely filled with new bone (Fig. 6). Right hip: well healed scar, no hernia.

Case 7. 2487/47. Aged 48 years. *Brodie's abscess in the lower epiphysis of the tibia*, the size of a walnut (Fig. 7). *Operation*, November 1947:

Radical excavation + implantation of bone chips + primary suture. Post-operative penicillin therapy. Highest temperature after operation 39.7° C, two days later normal. Discharged from hospital primarily healed. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Staphylococcus albus.

Follow-up, December 1948: Healed and free from discomforts since discharge from hospital. Scar well healed. X-ray examination: cavity obliterated by new bone (Fig. 8). Left hip: well healed scar, no hernia.

Case 8. 2209/47. Aged 13 years. *Brodie's abscess in the upper epiphysis of the tibia*, the size of a hazelnut. *Operation*, October 1947: Radical excavation + implantation of bone chips + primary suture. Post-operative penicillin therapy. Highest temperature after operation 37.7° C. Discharged from hospital primarily healed. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Staphylococcus albus.

Follow-up, December 1948: Healed and free from discomforts since discharge from hospital. Scar well healed. X-ray examination: cavity obliterated by newly formed bone. Left hip: well healed scar, no hernia.

Case 9. 305/48. Aged 28 years. *Chronic osteomyelitis in the upper part of the tibia* since 1927; after radical operation 1927 healed until 1944, thereafter open fistula. *Operation*, February 1948: Radical excavation + implantation of bone chips + primary suture. Highest temperature after operation 38.1° C. Discharged as primarily healed. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Gram-positive coccus.

Follow-up, October 1948: Healed and free from discomforts since discharge from hospital. Doing full-time work. Scar well healed. X-ray examination: cavity obliterated by new bone. Right hip: well healed scar, no hernia.

Case 10. 1770/47. Aged 23 years. *Osteomyelitis in compound fracture of the tibia*, which was primarily treated with intramedullary nailing. Infection in the compound fracture extended along the nail to a lower simple fracture. Suppuration from both fractures (Fig. 9). Extraction of the nail, January 1948. *Operation*, February 1948: Radical excavation of both foci + implantation of bone chips + primary suture over the lower fracture and primary covering of the upper by one week earlier delayed pedicled flaps. Post-operative penicillin therapy. Highest temperature after operation 39° C. Necrosis in one flap with exposure of the upper transplantation area. After 5 weeks the skin defect was filled with granulation tissue without any sequestrum formation of the chips and was then covered with split-skin grafts. Complete healing. Discharged as healed. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Staphylococcus aureus.

Follow-up, November 1948: Healed after discharge from hospital. Doing full-time work. Skin-grafts well healed in with good circulation. X-ray examination: fractures consolidated (Fig. 10). Right hip: well healed scar, no hernia.

Case 11. 243/48. Aged 32 years. *Osteomyelitis after compound fracture of the tibia*, at the age of 14 years, with a long interval free from symptoms. In 1947 a fistula opened over the old fracture. *Operation*, August 1947: Radical excavation + implantation of bone chips + primary suture. Primary healing. Highest temperature after operation 38° C. New fistula developed after two months. *Operation*, January 1948: Radical excavation of the same focus + implantation of bone chips + primary suture. Primary healing. Highest temperature after operation 38.1° C. After two months new fistula at same site and X-ray examination revealed a sequestrum. *Operation*, June 1948: Radical excavation + implantation of bone chips (taken from the same side as at operation in 1947!) + primary suture. On this occasion a further bone cavity was found, above that earlier operated on, and that had previously been overlooked. Post-operative penicillin therapy. Highest temperature after operation 38° C. Microscopic examination: chronic osteomyelitis. Bacteriological culture: Staphylococcus. Discharged as primarily healed.

Follow-up, December 1948: Healed since discharge from hospital. Well healed scar, no tenderness. X-ray examination: defect filled with newly formed bone. No signs of osteomyelitis. Right hip: well healed scar, no hernia.

Discussion.

From the reports of the cases it is seen that healing in of the implanted bone chips took place in 10 cases despite the fact that in 5 the process was complicated by necrosis in the skin covering the transplantation area, the uppermost layer of the chip-grafts being exposed. In this connexion the author had the same surprising experience as that reported by COLEMAN et al., *i. e.* that sequestrum formation did not take place in the exposed bone chips. Instead, they were gradually covered by granulation tissue growing from underneath. Skin grafting could later be carried out on this area. It is difficult to make a definite statement regarding the reason for the occurrence of the necrosis in the flaps. The fact that it occurred exactly above the transplantation area even in those cases in which well prepared delayed flaps were used can be an indication that the infection present locally — and possibly activated by the surgical intervention — attacked the flap of skin which despite all measures taken can never be adequately vascularized, thus causing thrombosis of the skin vessels and necrosis. In one case in which primary suture of the wound could be made, necrosis occurred in the margins with rupture of the wound because of too great tension of the sutures.

Although these complications had no deleterious effect on the final results, as far as it has hitherto been possible to ascertain,

our experience nevertheless indicates that the greatest care should be exercised in the preparation of the flaps since their primary healing obviously decreases the period of hospitalization considerably. It is possible that a longer time of preparation should be allowed for the displacement of the flaps with, for example, two or three underminings at intervals of about one week. This would increase the circulation in the flap and thus heighten its resistance to the presumed attack of the infection.

It will be noted that one patient was operated on three times owing to relapses but that he has now been healed for the last six months. In the writer's opinion, the penicillin therapy administered after the last operation does not explain the final healing. The cause would instead appear to be that two foci were found on the posterior aspect of the tibia, one of which had been overlooked at the previous operations and was only excavated and filled with chips at the third intervention. The position of the infected foci on the posterior aspect of the tibia made examination of the bone more difficult. Furthermore, X-ray examination did not give definite evidence of the presence of two foci.

One of the most important conditions for the success of bone grafting in infected cases is a satisfactory blood supply to the transplants. This can only be assured by means of radical removal of all sclerotic bone so that the transplantation bed is bordered on all sides by healthy, bleeding bone. Since both our own experience and that of other workers appears to indicate that cancellous bone in the form of chips heals in and forms new bone even if infection is present, no hesitation is necessary in making a radical excavation in order to obtain a well vascularized grafting bed even if a considerable defect is caused in the bone.

In the cases where necrosis of the skin gave rise to exposure of the bone grafts, we used vaseline ointment to which penicillin had been added and tried to avoid too frequent changing of the dressing (*i. e.* not more often than about once a week). As soon as the entire skin defect was covered with granulation tissue, the author performed a transplantation with split-skin grafts as the primary covering. If the skin-grafts later prove unable to withstand strain, it is always possible under favourable conditions to exchange them for a flap from the same or from the other leg.

OLDFIELD (1945) reported a case of a hernia in the field of operation over the iliac crest. This was a sliding hernia of the caecum after operation within the posterior area of the iliac crest in order

to obtain cancellous bone. No such complication occurred in our material nor did any of the patients state at the follow-up examinations that they suffered from any discomforts in the hip operated on.

The material reported in the foregoing is small and the observation time as yet too short to permit any definite conclusions. Nevertheless our experience is entirely in agreement with that published earlier by other workers. All facts appear to indicate that cancellous bone-chip grafts possess a remarkable viability with an unusual degree of resistance to infection, which makes this grafting material particularly suitable for the filling of infected bone defects.

Summary.

A short survey of the literature on experimental and clinical experiences of cancellous bone as a transplantation material is given.

The writer reports on 11 cases of osteomyelitic bone defects in which, following radical excavation of the defect, cancellous bone chips were implanted at the same operation in order to fill the cavity. In 10 of the cases the grafts healed in satisfactorily; in one case two further operations were necessary before healing was achieved. Follow-up examinations of the patients, in which the period of observation varied between six months and two years, show that in every case there was obliteration of the cavities by newly formed bone.

The author was able in five cases to confirm the observations made by COLEMAN et al., *i. e.* that even if the implanted chip-grafts were exposed through necrosis in the covering soft parts no sequestrum formation took place. After a few weeks the chips were entirely covered by granulation tissue growing from beneath. Skin grafting could subsequently be made on this surface with satisfactory results. Although the material is small and the time of observation short, the results achieved are so uniform and encouraging that the writer, as do earlier authors, feels justified in recommending this method for the treatment of infected bone defects.

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Treatment of Varicose Leg Ulcers.

By

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Chronic or recurring leg ulcers are a relatively common and particularly unwelcome complication of varices. Chronic leg ulcers of other etiology are not discussed in this paper. The successful treatment of these ulcers presupposes first and foremost effectual treatment of the fundamental cause, namely the varices. In the majority of cases in which varices are complicated by leg ulcers, the venous insufficiency is widespread, large varices being present in the region of both the large and small saphenous veins, as well as broad communications between these vascular areas and the deep veins, especially in the lower medial part of the thigh and the anterior medial part of the lower leg.

Radical treatment is nowadays deemed to consist in high ligation of the large saphenous vein in the fossa ovalis in close proximity to the sapheno-femoral junction. In this operation, not only is the large saphenous vein itself divided, but also, as a rule, three tributaries communicating with it; namely the superficial epigastric, the external pudendal and the superficial circumflex veins. This serves to lessen the risk of recurrence and at the same time to eliminate the danger of embolism from a stump of the large saphenous vein left too long. In the author's opinion a by no means inappreciable number of recurrences are due to an incorrectly performed high ligation. The operation itself should be combined with a concurrent injection of some sclerosing solution in the large saphenous vein. The small saphenous vein is ligated

in the upper part of the popliteal space, where it perforates the fascia. In recent years, American authors in particular have emphasized the importance of supplementing these surgical measures by the extirpation of the large saphenous vein in the above-mentioned parts of the high and lower leg, with ligation of the dilated communications with the underlying tissue. These measures should be implemented by injection treatment in the sequel. If the therapy outlined above is combined with some form of compression dressing over the leg ulcer, a large proportion of these ulcers heal definitively without further therapy, provided the ulcer itself is not too large or has not persisted too long.

In large ulcers, usually from 3 cm upwards in diameter, the epithelium growing over the granulations becomes thin and tautly fixed, the consequence being poor stability of the skin. With the completion of epithelialisation the majority of vessels in the underlying granulation tissue disappear, this being normal in all granulation tissue after healing has commenced. The epithelial nutrition now becomes insufficient, and a new ulcer ensues. If the ulcer is of long standing or has recurred several times, the subcutaneous tissue is deprived of more and more vessels and becomes increasingly sclerotic, the requisite conditions for chronic ulcer thus being present.

In these cases, the radical excision of all sclerotic tissue, together with subsequent covering of the defect by free skin grafts, is the procedure that has been increasingly resorted to in recent years, particularly among plastic surgeons. The method is not new.

In Sweden, G. NYSTRÖM presented a series of 45 cases treated after this principle as early as 1917 and 26 of these cases were followed-up, permanent healing being noted only in four. In 1924 NYSTRÖM described a further series of nine patients. On the basis of his previous experience, he had now made a really radical excision towards the periphery, cutting into tissue that was certainly intact and penetrating deeply to the muscle and periosteum. One patient could not be located for after-examination; one had a small recurrence within an area which, in NYSTRÖM's opinion, had not been excised radically; and in one case a recurrence was found in an area where the graft had not taken. The other six had remained healed between 7 and 22 months.

In 1936 S. VON STAPELMOHR published a paper on varices in which he advocated grafting according to Thiersch in surgical

interference with the leg ulcer itself, following radical excision of the ulcer.

In 1948 K. BOMAN presented a number of cases treated according to the so-called tunnel-graft method reported by KELLER.

Since the procedure recommended in the lastnamed excellent paper by G. NYSTRÖM is probably known only to a few surgeons in Sweden, and since the technique employed in surgical treatment of leg ulcers has been partially modified in recent years, the author proposes here to describe the way in which this technique has been developed by plastic surgeons.

Before the leg ulcer is excised, the patient should be confined to bed for one to two weeks with the leg elevated and Burow compresses on the ulcer. In this way the usually pronounced swelling in the leg subsides appreciably, and the ugly infected surface of the ulcer improves. Under spinal anaesthesia the ulcer is now excised radically, *i. e.* so far beyond the periphery of the ulcer itself that incision is made into palpably normal skin and subcutaneous tissue and down to or through the deep fascia. In performing this excision, substantial venous pools are not infrequently found directly beneath the ulcer. American authors have pointed out that these pools feed, so to speak, the ulcer. Should the underlying periosteum be fibrous and the bone sclerotic, the periosteum is excised and the sclerotic bone shaved off so as to ensure a good bleeding surface. In this way all changed fibrous tissue is removed. In many cases even wide circular defects are obtained after this radical excision. When bleeding has ceased ointment and bandages are applied and, if needed, a plaster cast.

Bright red granulation tissue forms within a few days, and after ten to fourteen days the surface is ready for final covering with a free skin graft. During this time any infection which may be present must be destroyed completely, this applying in particular to *Pseudomonas pyocyaneus*, the most dangerous enemy associated with skin grafting. Repeated bacteriological examinations of the ulcer secretion, together with determination of the bacterial resistance, are of great benefit when selecting the best antibacterial agents. No grafting should be undertaken if the plasma protein shows low values or if the haemoglobin is below 60 per cent; in such cases one or more blood transfusions is the correct therapy. When the wound is ready for grafting, the secretion is usually inappreciable and the peripheral epithelium commences rapidly to grow over the granulations. One day before

grafting, the wound should be moistened with sodium-chloride-solution.

The skin graft is taken as a rule from the back or outside of the thigh, this being effected best with the aid of a Padgett dermatome adjusted to intermediate thickness, *i. e.* 0.35—0.60 mm. A large number of small holes are then made in the graft with a knife or scissors to ensure good drainage. The wound surface is usually sprayed with penicillin, after which the skin graft is carefully sutured along the periphery, partly with interrupted silk sutures on which a long end is left, and partly with continuous sutures. Immediately over the graft is placed a single layer of gauze impregnated with simanit ointment; over this a thick layer of cotton wool soaked in flavin paraffin, and outside this gauze compresses or sponge rubber or steel wool. Over this combined dressing the long ends of the sutures are then tied. Finally an elastic bandage is applied outermost. If this dressing remains dry and odourless it should not be disturbed for seven days; but in the event of secretion and odour it is changed after three days. The dressing is then changed every third to fourth day being retained about 14 days, after which an elastic bandage alone is employed. After three weeks the patient is allowed to leave his bed, still wearing the elastic bandage, which should be retained for two months. During the first few weeks the elastic bandage is essential, obviating as it does minor haemorrhages beneath the skin graft. These haemorrhages might give rise to small necrosed areas in the graft, with a new ulcer as the result. Small haemorrhages of this kind are frequently observed in newly epithelialized surfaces in cases of burns, particularly on the lower extremities, if these patients are allowed to leave bed without compression dressings for more than very brief periods during the first few days after healing. In the usual way a complete "take" of the graft is obtained.

While some surgeons prefer to perform the excision and the graft in one stage, the present writer considers it best to wait for the healthy granulations before transplanting skin. In the one stage procedure it is necessary to overcome what is frequently a troublesome oozing of blood from the wound surface. Very small blood coagula beneath the graft also result in necrosis of that part of the graft located above the coagulum. Burning of the minute bleeding areas with a diathermic needle produces a small necrosed zone and involves the same risk of necrosis for the overlying

graft. The small holes in the graft constitute, it is true, a certain safety valve against any accumulation of blood; but in the two stage procedure this hazard is eliminated entirely.

In due course the skin graft rises to the same level as its surroundings, at the same time becoming increasingly mobile in relation to the underlying tissue, a condition which naturally tends to heighten the stability of the new skin. Should the graft subsequently exhibit a tendency towards new ulcers in spite of the treatment outlined above, *i. e.* ligation etc., followed by radical excision and free grafting, the therapy should be implemented by lumbal sympathectomy, provided that tests have first shown that improved circulation may be expected to result from such interference.

NYSTRÖM's series from 1917 included a large number of recurrences, and he emphasized in his discussion and demonstrated with photographs that virtually all these recurrences developed in the form of peripheral ulcers round the skin graft. In the present writer's opinion this strongly suggests that the excision in these cases was not sufficiently radical. Moreover, in NYSTRÖM's series from 1924, in which the excision had been fully radical, he was able to demonstrate excellent final results.

Some authors advocate the Reverdin graft in the grafting procedure itself, and in cases where it has not been possible to test the infection of the wound surface the percentage of takes is larger; but in these cases relatively thin so-called postage stamp grafts seem to be preferable.

According to the American surgeons REES and SLEVIN, there are very few contraindications for the modes of operative treatment described above. These assuredly do not include age, for 70 year-old, and indeed even 80-year-old patients have been treated with good results. Any diabetes and cardiac incomensation which may be present must be carefully treated preoperatively. In cases with severe infection or anaemia the operation must be postponed, and the same applies to pregnancy.

Both NYSTRÖM and VON STAPELMOHR employed Thiersch grafts, but since these latter are thinner than split-skin grafts their stability is poorer. As a general rule, of course, it may be said that thin grafts take far more readily, especially in tissue with poor nutrition; *but on the other hand the final result is poorer both from the functional and cosmetic points of view.* Hence there is no doubt that after radical excision of the ulcer,

where good conditions for nutrition are ensured, a relatively thick split-skin graft should be chosen.

In 1947, the American surgeon ROBERTSON and his co-workers reported 21 cases of leg ulcers treated in the manner described above. The oldest patient was 75, and the leg ulcers had a duration of up to 52 years, with an average of ten years. The largest area of skin grafted amounted to 560 sq.cm. Of ten cases subjected to follow-up examinations, eight showed excellent results and two had been reoperated upon, one for peripheral ulcers and the other for two small ulcers in the area where the graft had not taken primarily (cf. NYSTRÖM's results). All the patients had resumed work, and in occupations in which they had to stand all day.

At the Departments of Plastic Surgery of *Seräfimerlasarettet* and *S:t Görans Sjukhus*, Stockholm, a few cases have been operated upon in the above-mentioned way, with good primary results, during the past ten years. In those cases which suffered recurrences, the fundamental cause does not seem to have been treated radically enough.

In conclusion, two cases are described here. One of them — a 45-year-old woman whose almost circular leg ulcers were of many years standing — had been admitted for amputation. By radical excision and subsequent free skin grafting, the ulcers were rapidly healed. A moderately pronounced oedema distal to the ulcer disappeared almost completely after the operation. As NYSTRÖM has pointed out, the lymph circulation probably goes largely to the deep-lying tissues even prior to operation, and improves with healing of the infected ulcer. Before resorting to such a drastic measure as amputation, the procedure described above should unquestionably be tried.

The other case is that of a 29-year-old man who developed varices and leg ulcers five years ago following thrombosis. He had been treated with high ligation, injection therapy, zinc paste stocking and skin grafting in two stages, though without a previous excision. He had been hospitalized altogether for more than one year, having been unfit for work during this period and for a further eight months. Now and again the ulcer had healed, though never for more than a few weeks at a stretch. It will be readily understood what all this meant to so young a patient. Since the operation in April, 1948, the ulcers have remained healed and the patient has worked full time as an errand boy.

Summary.

Chronic or recurring leg ulcers are a relatively common and unpleasant complication of varices. If such ulcers are to be treated successfully, proper treatment of the fundamental cause, namely the varices, is of primary importance. This treatment consists in high ligation of the large saphenous vein, implemented, if necessary, by extirpation of certain varicose areas of the leg. The operation should be supplemented by the injection of sclerosing solution. If the leg ulcer itself is ultimately treated with compression dressings it usually heals definitely, provided it is not too large or has not persisted too long. In these cases a really radical excision should be undertaken, the incision being made outside the periphery in demonstrably intact tissue, and downward as far as, or even through, the deep fascia. Then follows an interval of ten to fourteen days, during which bright red, healthy granulations grow over the entire wound surface. The granulation surface is then covered with skin of intermediate thickness. Attention is drawn to the superiority of this graft compared with Thiersch and Reverdin grafts. The transplantation procedure is described in detail. In the great majority of cases this operation results in effective healing. In conclusion two cases are reported in which the treatment outlined above was fully successful.

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